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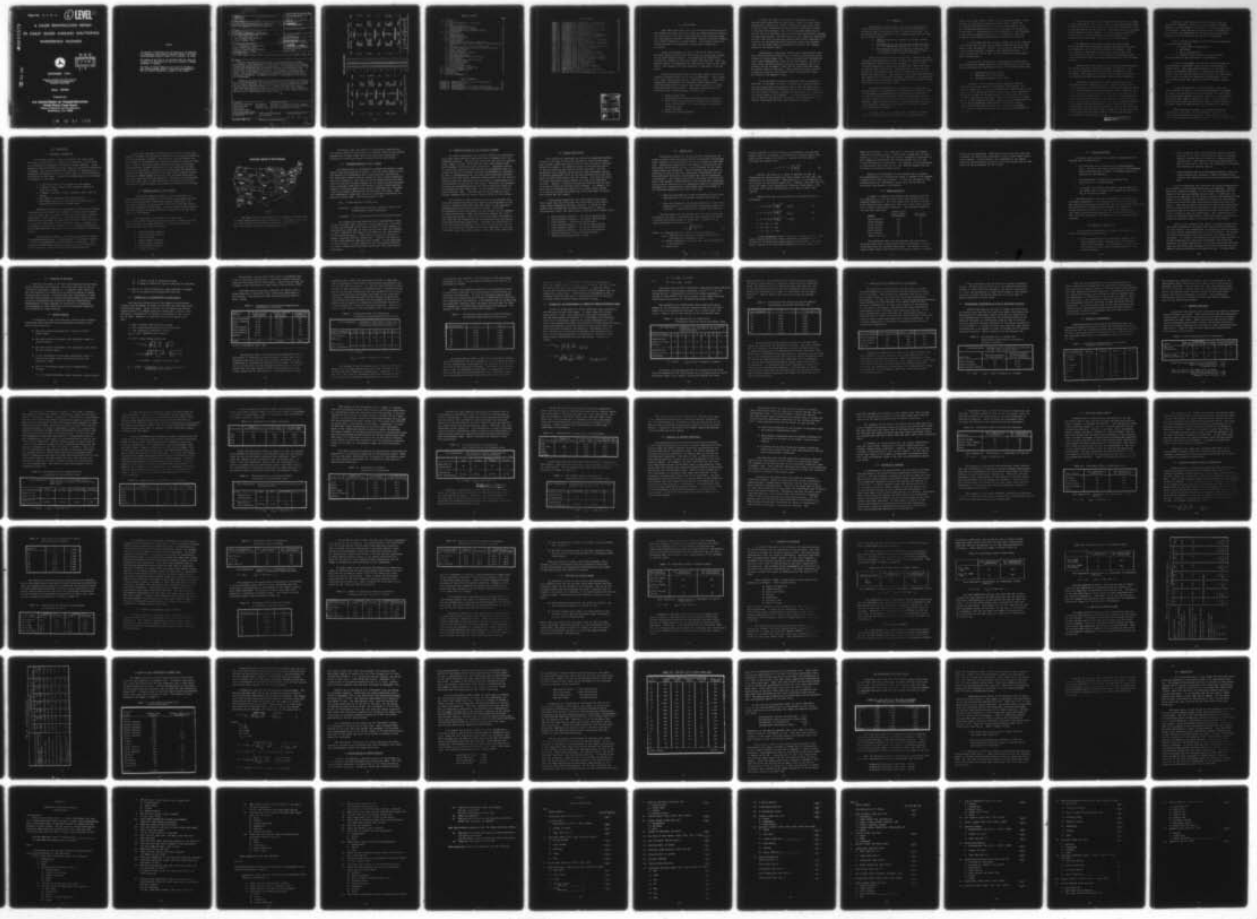

Report No. CG - D - 67 - 78

(6) LEVEL II



# A CAUSE IDENTIFICATION REPORT OF COAST GUARD AUXILIARY SAR/TOWING INTERFERENCE HAZARDS





SEPTEMBER 1978



FINAL REPORT

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
United States Coast Guard
Office of Research and Development
Washington, D.C. 20590

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The Coast Guard's Project Officer during this project was LT(jg) WALTER M. HUNT, JR.

16. Abstract

In this effort 800 active Auxiliarists were surveyed using a telephone questionnaire. The Auxiliarists were from seven Coast Guard Auxiliary districts experiencing reported high levels of interference. The Auxiliarists were randomly selected and questioned about interference cases and non-interference cases. The survey results were tabulated and analyzed for statistical significance and practicality in development of a solution. The procedures followed are given in detail. The results of the findings are presented in both general terms and statistical discussions. Recommended solutions to the problem are also attached in the Appendices.

In general, the study showed that interference is experienced by Auxiliarists on an almost random basis. The only areas which resulted in significant findings were in weather conditions and the fact that the longer an Auxiliarists patroled the more likely interference would occur. Overall, less than 10% of active Auxiliarist experienced interference on less than 3% of their towing assistance cases. Of those intereference cases less than 30% resulted in damage (always less than $50) and no cases resulted in personal injury.

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# METRIC CONVERSION FACTORS

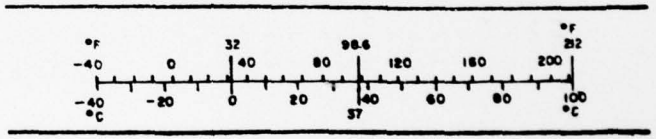
## Approximate Conversions to Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| in | inches | *2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | *kilometers* | km |
| | | **AREA** | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| | | **MASS (weight)** | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| | | **VOLUME** | | |
| tsp | teaspoons | 5 | milliliters | ml |
| Tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | *fluid ounces* | 30 | *milliliters* | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| | | **TEMPERATURE (exact)** | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.


## Approximate Conversions from Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| | | **AREA** | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares (10,000 $m^2$) | 2.5 | acres | |
| | | **MASS (weight)** | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| | | **VOLUME** | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 35 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| | | **TEMPERATURE (exact)** | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



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## 1.0 INTRODUCTION

The Coast Guard Auxiliary is a civilian volunteer organization formed to assist the Coast Guard in promoting boating safety. The activities of the Coast Guard Auxillary are centered around four cornerstone programs: Operations, Courtesy Motorboat Examination, Public Education, and Fellowship. This report focuses on the activities of the Auxillary in the first cornerstone - Operations.

Since its inception in 1939 as the Coast Guard Reserve, the Coast Guard Auxiliary has been active in operational support of the Coast Guard's mission. As authorized in implementing legislation, members of the Coast Guard Auxiliary use their own private vessels to supplement the operational forces of the Coast Guard. This support has been primarily in the area of boating safety.

Surface operational work of the Coast Guard Auxiliary is normally performed under one of two circumstances: under direct Coast Guard authorization or on a voluntary basis. Under both categories, Auxiliarists are required to wear appropriate uniforms and mark their vessels with identification as a Coast Guard Auxiliary Patrol Vessel. Typically, Auxiliarists are involved in the following types of activities:

- o Safety patrol work
- o Assisting other vessels, including towing operations
- o Other forms of assistance to vessels not including towing operations, i.e., engine repair, dewatering, refueling, etc.
- o Regatta patrols
- o Search and rescue missions

As early as 1974, the Director of Auxiliary for the Twelfth Coast Guard District submitted a letter to Coast Guard Headquarters stating that towing interference was being experienced by Coast Guard Auxiliarists while on operational patrol. To alleviate this problem, the letter suggested authorization for the use of a flashing light by Coast Guard Auxiliarists engaged in towing activities. The rationale for this suggestion emphasized the fact that most recreational boaters have little knowledge of the Rules of the Road and would therefore relate the flashing light to the signal used by emergency vehicles on the highway system of the United States.

Subsequently, additional reports were received from other Coast Guard Districts complaining of similar interference while engaged in towing operations. These proposals were forwarded to Coast Guard Headquarters, Rules of the Road Branch. Review by that branch indicated conflict between the proposed use of a flashing yellow (or amber) light and the authorized uses under the present Rules of the Road. These authorized uses included a submarine running on the surface under International Rules and barges on the Western rivers.

At the National Auxiliary Conference held at Baltimore, Maryland, in September of 1976, a request was formally made by the Coast Guard Auxiliary National Board that the Coast Guard develop some system of alleviating towing interference hazards. The first step in finding a system of alleviation is to determine the actual scope of the problem. It is the purpose of this report to define the scope and the nature of the problem of interference experienced by Coast Guard Auxiliary vessels.

## 2.0 OVERVIEW

The purpose of this report is to define the problem of interference experienced by Coast Guard Auxiliarists while performing Search and Rescue (SAR) or towing operations. Interference has been defined as any occurance which met at least one of these criteria:

1. Damage occurred as a result of another vessels actions.
2. The approach of the interfering vessel was such as to be reasonably categorized as a near miss.
3. The approach of the interfering vessel was such as to require emergency maneuvers on the part of the Auxiliarist to avoid collision.

Seven Coast Guard Auxiliary Districts, selected for geographical representation as well as being the districts reporting most cases of interference, were surveyed. A total of 800 "active" Auxiliarists (those who had done more than nine hours of patrol) were interviewed. The questionnaire used elicited details of interference cases as well as details of cases not marred by interference. The results of the survey were tabulated and subjected to statistical analysis. Details of the analysis and findings of "statistical significance," are contained in the applicable sections of this report.

This overview presents the findings of the analysis in general terms. Such expressions as significant findings, level of confidence or probability of interference are used with definative statistical meanings within the analysis sections. No such restrictions are placed on their use in this overview section. They are used as part of a generalized definition of the problem of interference and therefore are not intended to carry statistical meanings.

Overall, there is a "significant" problem of vessels interfering with Coast Guard Auxiliary surface operations.

Almost 10% of the "active" Auxiliarists have experienced interference on 3% of their towing assistance cases. While the percentages indicate that this is not a large problem, it is an identifiable problem and in that light should be considered "significant." The magnitude of the problem is in part measured by the cost of damage resulting from interference, which is estimated to be no more than $24,342 nationwide during 1977.

Of those Auxiliarists surveyed, almost 10% of the "active" Auxiliarists had at least one assistance case during which some other vessel interfered. However, the data also indicated that it was a more prevalent problem in the Twelfth District. In that district over 21% of the "active" Auxiliarists had experienced interference.

Out of all of the cases of interference the Auxiliarist was performing a towing operation (from astern) most of the time. Interference was not experienced during the following operations:

1. Dewatering another vessel.
2. Searching for a lost boater.
3. Assisting a boater out of fuel.

Therefore, it is during a towing operation that an Auxiliarist is most likely to experience interference. An "active" Auxiliarist is likely to experience interference on less than 3% of all towing assistance cases in the target districts. And there is only a 0.7% chance that the Auxiliarist will experience interference that would result in any damage. In other words, in the districts studied, Auxiliarists performed 99.3% of their towing assistance cases without interference which required more than evasive maneuvers. They also performed 97.5% of their towing assistance cases without interference of any type.

Of the interference cases studied none resulted in damage of more than $50.00. This would indicate that most damage cases resulted in scrapes along the side or possibly cracked gel coats as the tow rode up on the facility. There were no cases revealed which resulted in major damage. It should also be noted that in over 70% of the interference cases the actions of the Auxiliarist involved were sufficient to prevent damage.

An analysis of the types of Auxiliary Facilities failed to show any relationship between the type of facility and whether or not the Auxiliarist had interference. The data failed to show that an Auxiliarist in a 20 foot open motor boat has any more or less chance of experiencing interference than does the Auxiliarist patrolling in a 42 foot cabin cruiser.

About 97.2% of the cases of interference occurred during the period from April through September inclusively. Also 72.9% of the interference cases occurred between July and September. This tends to coincide with the boating seasons in the districts studied and therefore offers no real surprise.

The weather conditions for interference cases were compared with non interference cases. There was very little difference found in wind conditions, although the wind was about 2 mph (3.2kph) higher during interference cases. However, the sky is generally clearer during interference cases than it is during non-interference cases. A comparison of the visibility conditions failed to show any real difference on interference cases. It was also discovered that the water conditions tended to be rougher during interference cases. More of the interference cases occurred during choppy and rough water conditions than was the rule for other cases. Normally interference cases happen during daylight hours (98% of the Auxiliarists work load happened between dawn and dusk).

Whether or not the Auxiliarist's Facility has any distinctive features , such as a flying bridge or unusual markings, does not seem to be a factor in the experiencing of interference. From the data studied, there is no reason to believe that the appearance of the Auxiliary Facility has anything to do with causing or avoiding interference.

There is also no reason to believe that the carrying of special gear such as:

- o a bull horn (or loud hailer)
- o spotlights
- o patrol sign boards, or
- o special lights (such as flashing lights)

has any affect on the occurance of interference.

As far as the number of hours of patrol work done by Auxiliarists is concerned, there is some relationship to interference. This relationship shows up in the Ninth Central and Twelfth Districts. In those two districts it appears that the more an Auxiliarist patrols, the more likely it is that he or she will experience interference. This relationship holds true especially over 50 hours of patrol work.

In the Third Northern, Third Southern, Fifth, and Twelfth Districts there is a relationship between the number of assistance cases an Auxiliarist performs and interference. This relationship shows itself most clearly for Auxiliarists performing more than 10 assistance cases. As with patrol hours the more work the Auxiliarist does (in those districts) the more chance of experiencing interference he or she has.

Since the use of flashing or rotating lights was suggested as a solution to the problem of interference, this factor was studied separately. The analysis of that data failed to show any evidence that the carrying of such lights

has any impact on causing or avoiding interference. Eleven per cent of the Auxiliarist surveyed had special lights installed and used them when performing assistance cases. The analysis failed to show that carrying such lights changed the chances of experiencing interference.

An analysis of the training status of "active" Auxiliarists and whether or not they had experienced interference was made. The analysis indicated that training does not seem to be a factor in the occurrence of interference. It should be realized that the current training courses do not make direct reference to interference per se. Therefore the impact of Auxiliary training courses would be expected to be tangential to the problem of interference. But the analysis does lend support to the supposition that interference occurs regardless of the involvement of the Auxiliarists. In other words, every Auxiliarist is as likely to experience interference.

A comparison was made between the districts surveyed and the other districts in the United States. After making certain assumptions (detailed in the applicable sections) the following estimates of the nationwide scope of the problem were made:

- There are <u>at most</u> 896 "active" Auxiliarists who have experienced interference during 1977.
- There have been <u>at most</u> 1,653 cases of interference during assistance cases in 1977.
- The total cost of damage from interference during 1977 is <u>at most</u> $24,342.
- The year 1977 is representative of other years as far as Auxiliarists experiencing interference is concerned and that 1977 was an average year for Auxiliary activity.

## 2.1 GENERAL DESCRIPTION OF THE PROBLEM

Coast Guard Auxiliarists have experienced interference in their work to a measureable degree. It is unlikely that this

interference happens on assistance cases other than towing cases (while towing astern). In most of the situations that an Auxiliarist will experience interference, that Auxiliarist should be able to avoid damage by defensive maneuvers. It is unlikely that using flashing lights, special signs, or distinctive features on their facilities will prevent interference from happening general the only defense against interference is remaining aware of its possibility and being ready to maneuver clear of the interfering vessel. The interference will normally happen in daylight hours, the seas will likely be a little rougher than at other times, but the sky will probably be clear. The vessel causing the interference could easily be an open motor boat, a cabin cruiser, or a sailboat. But even if interference cannot be avoided and if damage results, the cost of that damage is very unlikely to be more than $50.00. There will most likely be no personal injuries resulting from interference.

## 3.0 BACKGROUND

### 3.1 AVAILABLE INFORMATION

The primary source of data concerning the Coast Guard Auxiliary is contained in a computerized personnel system known as the Auxiliary Management Information System (AUXMIS). Every member of the Coast Guard Auxiliary supplies information maintained in AUXMIS. The system performs two function, it maintains the background information about each member and it records membership activities for each year. Through the AUXMIS system the following information is available:

- o A ten-digit identifying number for each member
- o A member's name, address and telephone numbers at work and at home
- o A member's facility (boat, airplane, radio) and its status
- o The member's qualifications and training
- o The number and type of activities performed by the Auxiliarist during the calendar year.

Generally the activity information in the area of surface operations is restricted to the number of hours the individual spent on patrol and the number of times the Auxiliarist rendered assistance to other boaters. No information is contained in AUXMIS as to the number of cases that involved towing operations or as to the conditions of the individual cases. Likewise, no information is available in AUXMIS as to the damage incurred by Coast Guard Auxiliary facilities in the performance of operational duties.

In the event of damage to an Auxiliary facility engaged in authorized operations, the Auxiliarist is required to submit a claim for reimbursement to the Director of Auxiliary. This claim for reimbursement undergoes several levels of review involving possible investigation by Coast Guard officials.

Other than the above information, no sources of data were readily available that directly pertained to the surface operations towing interference problem. Additionally, certain factors led to a degree of uncertainty as to the feasibility of using the above data. Many of the Coast Guard personnel involved in the Coast Guard Auxiliary program firmly believe that Auxiliarists under report their activity. This belief is based upon the stated objections of many Auxiliarists to the paper work involved in maintaining the AUXMIS system as well as upon isolated cases where the under reporting could be measured. Therefore, it was decided that the first step in identifying the problem would be active collection of data to define the extent and nature of the problem.

## 3.2 EXPECTED SCOPE OF THE PROBLEM

Since 1974 frequent reports of been received by the Coast Guard detailing cases of interference experienced by Coast Guard Auxiliarists while performing towing operations. The increased frequency of these reports over the years has focused national attention to the issue . However, most of these reports have been general in nature and lack definition as to the exact extent of the problem.

The majority of the reports of interference were received from four Coast Guard Districts. These four Coast Guard Districts are subdivided into a total of seven Coast Guard Auxiliary Districts as follows:

- Third Northern District
- Third Southern District
- Fifth District
- Ninth Central District
- Ninth Eastern District
- Ninth Western District
- Twelfth District

## AUXILIARY DISTRICTS AND REGIONS

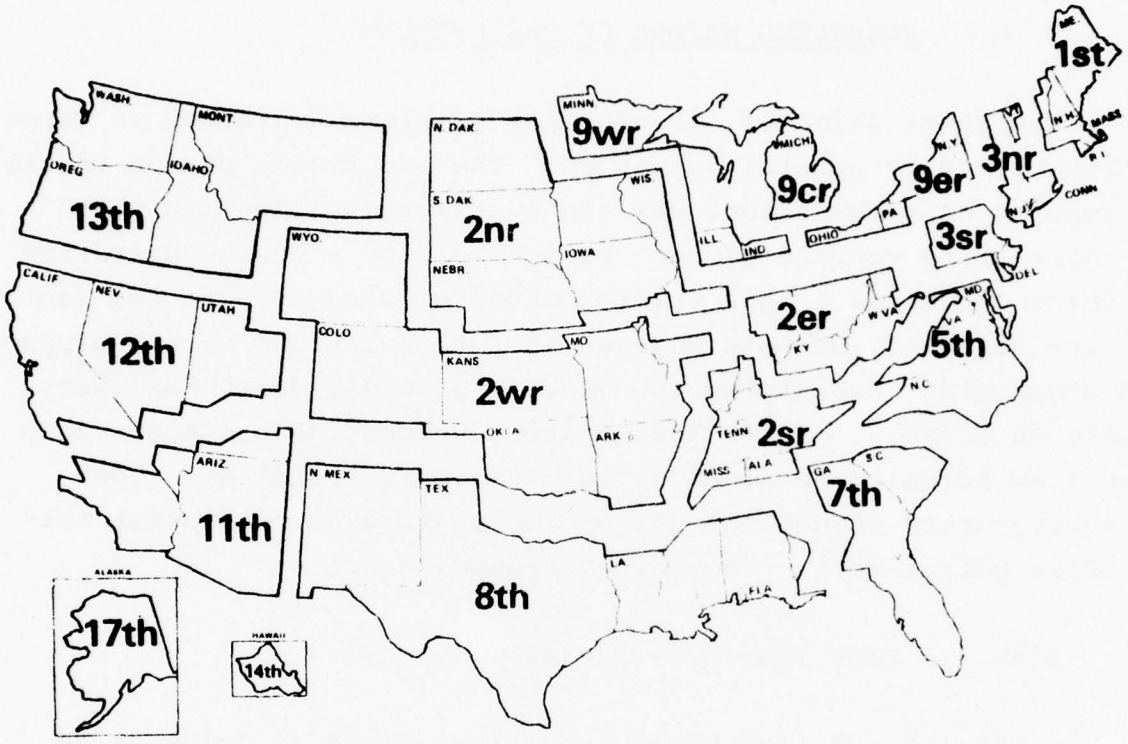


Figure 1

The above figure illustrates the geographical distributions of Coast Guard Auxiliary Districts/Regions. Throughout this report the terms "District" and "Region" are used interchangeably when referring to Auxiliary organizational units.

Therefore, while the number of Auxiliarists experiencing the problem cannot be quantified on a national basis by the reports, examination of these seven Coast Guard Auxiliary Districts is expected to reveal the largest concentration of the problem.

### 3.3 SUSPECTED NATURE OF THE PROBLEM

The description of interference problems contained in these reports were very general in nature. The one factor common to all the reports of interference was the Auxiliarists' feeling that the interfering vessels did not recognize that a towing operation was being conducted. This opinion was expressed despite the fact that the Auxiliary vessels engaged in the operations were equipped with signboards identifying the vessels as Coast Guard Auxiliary vessels on official patrol. These patrol signboards are a standard issue item normally obtained by the Auxiliary flotillas. They are subsequently issued for use by the individual Auxilarist for specified patrol work. They are designed to be:

Size - 4 feet long by 9 incles wide

Lettering - 3 inch block lettering, black in color on an international orange background

Statement - "U. S. Coast Guard Official Auxiliary Patrol"

The reports received indicated that interference in Auxiliary operations was limited to towing operations. The interference was detailed as the close approach of other vessels to the Auxiliary craft and the vessel being towed (but not between) in such a manner as to create an impedement to the continuation of the towing operation. Some cases reported collisions and damage resulting from the interference. However, the majority of the cases detailed reported "near misses". At the beginning of this project it it was unknown if the interference extended to forms of Coast Guard Auxiliary operations other than towing operations.

## 3.4 POSSIBLE BIASES TO THE SUSPECTED PROBLEM

As stated previously, the earliest reports of interference with Coast Guard Auxiliary operations were accompanied by a recommended solution. The solution called for the use of a flashing light, amber in color, to be used by Coast Guard Auxiliarists while engaged in official towing operations. Repeatedly during the three year period in which reports of interference were received the use of a flashing light was recommended as a solution. In fact, a recommendation by the Coast Guard Auxiliary National Board to the Coast Guard, requested authorization for the use of a flashing light and specified reported cases of interference as a justification for the use of that light. Therefore, the proposed solution was recommended before the entire scope and nature of the problem had been identified. As the popularity of the proposed solution grew, the solution of the problem received greater emphasis than the actual identification of the problem.

As a result of the attention given to the proposed solution most Auxiliarists were more aware of the advantages of the use of a flashing light than they were aware of the potential problems the solution was intended to solve. This bias was evidenced during the conduct of this project by the comments of many Auxiliarists. They indicated many reasons the flashing light was needed in their operations and then, subsequently, that they had not experienced any interference while performing Coast Guard Auxiliary operations. Therefore the collection of data had to be performed with this bias in mind so that the reports received would be based upon actual experience of the Auxiliarists rather than their desire to have the light authorized.

## 4.0 SURVEY PREPARATION

As a result of uncertainties related to suspected problems, as well as the lack of detailed information from the available data sources, additional data collection was required to properly define the problem. A telephone survey of Auxiliarists active in surface operation was used to collect the data. For the purposes of this project, an Auxiliarist was considered "active in surface operations" if he or she had performed more than nine hours of patrol work during the 1977 season. The hours on patrol included time spent as both skipper and crew of an Auxiliary facility. However, a further stipulation required that the Auxiliarists surveyed be facility-owning members. In summary, the Auxiliarists selected must have been at least partial owners of a facility and have completed more than nine hours of patrol work during the 1977 season.

A statistical population was then defined using seven Coast Guard Auxiliary Districts from which most of the towing interference complaints had been received. A search of the AUXMIS file revealed the following distribution of "active Auxiliarists" within the seven target districts (as of August 1977):

- Third Northern District - 557 active Auxiliarists
- Third Southern District - 129 active Auxiliarists
- Fifth District - 564 active Auxiliarists
- Ninth Central District - 195 active Auxiliarists
- Ninth Eastern District - 351 active Auxiliarists
- Ninth Western District - 211 active Auxiliarists
- Twelfth District - 255 active Auxiliarists
- Total Active Auxiliarists - 2,262

## 4.1 SAMPLE SIZE

The primary purpose of the project was to determine the extent to which Coast Guard Auxiliarists experienced interference while engaged in surface operations such as towing and other SAR work. Information pertaining to the number of Auxiliarists who experienced interference as well as the frequency of the interference cases was collected. Survey questions were designed to determine if Auxiliarists who experienced interference did anything different from those Auxiliarists who did not experience interference. THe primary objective of the Cause Identification Report then became a determination of the statistical probability that an active Auxiliarist will experience cases of interference. Estimates of a statistically valid sample size can be made if the following assumptions are held to be true:

- That the distribution of the activities of Coast Guard Auxiliarists will appoximate a Normal distribution.

- That the probability of any one Auxiliarist experiencing interference is a statistically independent factor and therefore, is described by the Binomial distribution.

The expression for the maximum error (E) of an estimated probability was used to determine how large a sample was needed to attain the desired degree of precision. Equation (1) was used to determine the maximum error.

$$E = Z_{\alpha/2} \cdot \sqrt{\frac{p\ (1 - p)}{n}} \qquad (1)$$

where: E = maximum expected error in sample probability

$Z_{\alpha/2}$ = standard unit measuring standard deviations at corresponding confidence levels

p = actual probability (in this case, actual probability of interference)

n = sample size

Solving Equation (1) for the value n (representing the required sample size) it is possible to estimate the required sample size under various levels of precision. Equation (2) was used to determine the sample size.

$$n = p\ (1 - p) \left[\frac{Z_{\alpha/2}}{E}\right]^2 \qquad (2)$$

However, the value of p used in Equation (1) and (2) represents the actual probability being sought; in this case, the probability of interference. Substituting p = 1/2 in Equation (2) will result in the largest sample size. However, this will make the resulting sample size unnecessarily large for cases where p does not equal 1/2; but all eventualities will have at least been covered.

Sample sizes were then calculated for varying degrees of confidence.

- $n = \frac{1}{2}\ (1-\frac{1}{2}) \left[\frac{1.96}{.05}\right]^2 = 384.2$ (2)
- $n = \frac{1}{2}\ (1-\frac{1}{2}) \left[\frac{2.06}{.04}\right]^2 = 663.1$ (2)
- $n = \frac{1}{2}\ (1-\frac{1}{2}) \left[\frac{2.17}{.03}\right]^2 = 1308.0$ (2)
- E = .05, n = 385
- E = .04, n = 664
- E = .03, n = 1308

If the assumptions prove to be true, a sample size of 1,308 active Auxiliarists would yield a statistical estimate of the probability of Auxiliarists experiencing interference. This estimate is within 3% of the actual probability with at least a 97%

degree of certainty. It is important to note that the sample sizes were calculated using a "worst case" probability of interference, i.e., p = 1/2, and that either increases or decreases in this probability would lower the required sample size for the respective degrees of confidence. For example, if the probability of interference were equal to 1/4, the required sample size for 97% level of confidence would be 981.

Because one requirement of this project was to analyze the characteristics of interference cases (a subset of the sample), a sample size of 800 was selected. In this way estimates of the characteristics of interference cases could also be made at relatively high degrees of confidence.

## 4.2 SAMPLE SELECTION

In order to identify the Auxiliarists actually selected for questioning, a list of active Coast Guard Auxiliarists was numbered sequentially. The total sample size of 800 was distributed proportionally according to the size of the target population in each of these seven districts. The following distribution was then generated:

| Region | (August 1977) Size of Target Population | Target Size of Sample |
|---|---|---|
| Third Northern | 557 | 197 |
| Third Southern | 129 | 47 |
| Fifth District | 564 | 199 |
| Ninth Central | 195 | 69 |
| Ninth Eastern | 351 | 124 |
| Ninth Western | 211 | 74 |
| Twelfth District | 255 | 90 |

The assumption that the Auxiliarists were distributed Normally within each of the target districts allowed the use of applicable means and standard deviations. The Normally distributed random numbers were generated and used to select the Auxil-

iarists to be questioned. Additional Auxiliarists were selected as needed, utilizing free replacement in the random number generation process. In this manner, the randomness of the sample selection was maintained and every active Auxiliarist had an equal chance of being selected for the survey.

## 4.3 THE QUESTIONNAIRE

The survey questionnaire was carefully prepared so as to consider the following points:

- o The questions were written so as to avoid possible bias. This was especially critical due to the suspected bias of Auxiliarists in favor of flashing lights as a solution to interference.

- o The phraseology was designed to minimize the possibility of a induced answer.

- o A "canned" introduction was used to add uniformity to the survey and to increase the credibility and authority of the survey itself.

The questionnaire used for the conduct of this survey is enclosed as Appendix A. The coding sheet used to record survey data collected from those Auxiliarists who had interference and those who did not have interference are included in Appendix B. It should be noted that Part II of the survey was completed in only those cases where Auxiliarists had experienced interference. Part I of the questionnaire was completed for all Auxiliarists surveyed.

## 4.4 CONDUCT OF THE SURVEY

The following factors were considered in selecting the staff to perform the actual survey:

- o Staff personnel had to be thoroughly familiar with both telephone survey procedures and the expected analysis of the data. In this manner, careful attention could be given to the critical factors of the data collection.

- Staff personnel had to be thoroughly familiar with the workings of the Coast Guard Auxiliary and its program, thereby allowing them to establish a rapport with the Auxiliarists. This rapport enabled the Auxiliarists to feel at ease and to talk with the interviewer in a jargon with which he or she was familiar.

- Staff personnel had to be thoroughly familiar with the subject matter and, therefore, ready to provide variations of the question that would elicit accurate, reliable data.

Prior to conducting any interviews the survey questionnaire was reviewed by Coast Guard Headquarters and approved. Efforts were made, wherever possible, to use coding compatible with the coding of the Boating Accident Reports (BAR). In addition, all directors of Auxiliary for the target districts were advised of the purpose of the project, and requested to notify all Auxiliarists within their districts that an authorized survey was being conducted. They were carefully instructed to advise the Auxiliarists that the survey would focus on matters of Coast Guard Auxiliary Operations and not to advise Auxiliarists that the subject of the survey related to cases of interference. This approach was designed to encourage Auxiliarists' cooperation and to prevent preconceived opinions biased by a concern about interference.

Early in the conduct of the survey it became apparent that additional screening of selected Auxiliarists would be required. In a few cases it was learned that the Auxiliary facility owned by the person being interviewed was in fact an aircraft. If the Auxiliarist had performed only air operations, the survey was discontinued. If, however, the Auxiliarist had also been involved in surface operations the survey was continued, restricting the questions to surface operations. It was also noted that many husband and wife teams were involved in surface operations and both members jointly patrolled on the same facility. In these cases

the survey was restricted to the family member who had completed the greatest number of hours as patrol skipper. The other Auxiliarist was eliminated from selection in the sample. It should be noted that the elimination of aircraft facilities and husband and wife teams in effect decreased the target population and therefore increased expected degrees of confidence obtained due to the sample size.

Some Auxliarists selected for participation in the survey could not be interviewed. Some of the reasons for this inability to participate were:

- o The Auxiliarist had died
- o The Auxiliarist had moved
- o The Auxiliarist refused to be questioned
- o The Auxiliarist was hospitalized

For those cases in which the interview could not be completed or the Auxiliarist was eliminated from consideration as outlined above, additional random numbers were generated utilizing free replacement. As a result survey interviews were attempted with approximately 1,600 Auxiliarists in order to complete the 800 interviews of the sample.

From the beginning of the conduct of the survey it became apparent that judgmental decisions would have to be made concerning the data collected. These judgmental decisions, however, were limited to the following areas:

- o Patrol hours - When an Auxiliarist indicated that many of his patrol hours would not have been included in the date of the AUXMIS printout, the Auxiliarist's estimate was accepted.

- Facility information--In those cases where the Auxiliarist either predominantly or entirely crewed during the past season, the facility described was the one on which the majority of patrol hours or interference cases were experienced.

- Features--Same comment as facility information.

- Additional gear--Same comment as facility information.

- Times interfered with on the assistance cases--In many cases Auxiliarists claimed that they had been subject to interference during a large number of their cases. However, after further questioning it often became apparent that the interference caused no damage and could not even be classified as a near miss. For example, one Auxiliarist classified a boat passing at a range of 500 yards as a case of interference. Therefore, cases were not classed as interference cases unless at least one of the following three criteria was met:

    1. Damage occurred as a result of the interference.
    2. The approach of the interfering vessel was such as to be <u>reasonably</u> categorized as a near miss.
    3. The approach of the interfering vessel was such as to require emergency evasive maneuvers on the part of the Auxiliarist.

  If during the discussion with the Auxiliarist it was believed that any one of the three criteria had been met the case was classified as an interference case and Part II of the survey was completed.

## 5.0 ANALYSES OF THE DATA

The data collected in the 800 interviews with active Coast Guard Auxiliarists was tabulated and coded according to the instructions contained in Appendix B. A computer data base file was then compiled and subjected to an editing program to detect erroneous data entries. Programs were then constructed to tabulate the data according to various characteristics of the cases involving interference and those not involving interference. Documentation of these programs is contained in a separately bound Appendix to this report and are not considered essential for evaluation of these findings.

### 5.1 OVERALL RESULTS

A tabulation of the collected data revealed the following information about the 800 active Auxiliarists surveyed in the seven target districts:

- The Auxiliarists patrolled for a total of 55,851 patrol hours.
- The Auxiliarists performed 5,909 assistance cases involving towing.
- The Auxiliarists performed 3,648 assistance cases which did not require towing.
- In the performance of the above assistance cases 78 Auxiliarists experienced interference during 146 assistance cases.
- The 146 interference cases can be categorized as follows:

  (1) 129 towing assistance cases (generally towing astern).

(2) 9 "Other" types of assistance cases.

(3) 8 cases for which the type of case was not reported.

- Only 43 of those interference cases resulted in damage and in no case was the damage more than $50.

## 5.2 PROBABILITY OF INTERFERENCE BY AUXILIARIST

The data was collected as to the number of Auxiliarists surveyed and the number of those Auxiliarists who had experienced interference cases. Using a formula for estimating the maximum expected error of a sample proportion based upon a finite target population, estimates of our degree of certainty of the results can be made. Equation (3) was used with the following input data:

$n = 800$ = "Active" Auxiliarists surveyed

$x = 78$ = Auxiliarists experiencing interference

$\alpha = .04$ = Degree of confidence measure

$Z_{\alpha/2} = 2.06$ = Standard unit measure

$N = 5137$ = Total target population

$$E = \pm Z_{\alpha/2} \sqrt{\frac{\frac{x}{n}\left[1 - \frac{x}{n}\right]}{n}} \cdot \sqrt{\frac{N - n}{N - 1}} \qquad (3)$$

$$E = \pm 2.06 \sqrt{\frac{\frac{78}{800}\left[1 - \frac{78}{800}\right]}{800}} \cdot \sqrt{\frac{5137 - 800}{5137 - 1}}$$

$E = \pm 0.0199$ = MAXIMUM EXPECTED ERROR

$\frac{x}{n} = 0.0975$ = Probability that an Auxiliarist will experience interference

We therefore can say with a 96% level of confidence that 9.75% of the active Auxiliarists in the seven target Auxiliary districts have experienced interference. And we can say that our estimate of that percentage is good within plus or minus 1.99%.

The same calculations were conducted for each of the 7 target districts to determine their individual percentages of interference. The results of these calculations are shown in Table 1 below.

TABLE I: Percentage of Auxiliarists Experiencing Interference in CY 1977

| District/ Region | % of Auxiliarists Experiencing Interference | Maximum Expected Error in Percentage | Extrapolated Number of Auxiliarist |
|---|---|---|---|
| Third Northern | 7.73 | ± 3.62 | 103 |
| Third Southern | 8.33 | ± 7.66 | 26 |
| Fifth | 6.06 | ± 3.20 | 76 |
| Ninth Central | 14.29 | ± 8.02 | 67 |
| Ninth Eastern | 6.45 | ± 4.12 | 43 |
| Ninth Western | 12.16 | ± 7.22 | 60 |
| Twelfth | 21.11 | ± 8.21 | 132 |
| TOTAL | 9.75 | ± 1.99 | 506 |

Level of Confidence used = 96%

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The column in Table 1 entitled "Maximum Expected Error in Percentage" is different for each district in that this value is dependent upon both the size of the target population and the probability of interference detected by the sample. By comparison it can be noted that the maximum expected error in the percentage for the total sample of 800 is much smaller than the errors listed for any one district. According to the maximum

expected error listed, the 12th District might in fact have a lower percentage of Auxiliarists experiencing interference than say the 9th Central District. To test for the statistical possibility of this occurrence a Chi-squared test of proportions was made using the Null hypothesis that the probability of an Auxiliarists experiencing interference was equal in all seven test districts. The observed number of Auxiliarists experiencing interference was then compared with the number of Auxiliarists which would be expected to experience interference (using the 9.750% probability) in each of the test districts. Table 2 illustrates the results of the Chi-squared test for proportions.

TABLE 2: Chi-Squared Test for Proportions
Interference Experienced by Auxiliarists

| Null Hypothesis: Probability that Auxiliarists will experience interference is the same in all seven Auxiliary Districts | | | | | | | |
|---|---|---|---|---|---|---|---|
| District/Region | 3N | 3S | 5 | 9C | 9E | 9W | 12 |
| Interference Observed | 16 | 4 | 12 | 10 | 8 | 9 | 19 |
| Expected by Null Hypothesis | 18.92 | 4.68 | 19.31 | 6.83 | 12.09 | 7.22 | 8.78 |

$\chi^2 = 18.87$

$\chi^2_{.05} = 12.592$ (6 degrees of freedom)

The results of the Chi-squared test reject the Null hypothesis that all test districts have the same probability that Auxiliarists will experience interference. Therefore it can be said (at a 95% level of confidence) that the probability that Auxiliarists will experience interference is in fact different

in the seven test district. The difference in the percentages displayed in Table 1 are therefore considered too large to be attributed to chance.

However, the question remans as to which Districts have a significant difference in the percentage of Auxiliarists experiencing interference. In order to determine exactly which Districts have significantly different probabilities of Auxiliarists experiencing interference, a Chi-squared test for proportions were performed comparing each individual district with the overall probability of Auxiliarists experiencing interference. The results of these tests are detailed in Table 3.

TABLE 3: Chi-Squared Tests Results by District/Region Interference Experienced by Auxiliarists

| District/Region | $\chi^2$ | $\chi^2_{.05}$ (df = 1) |
|---|---|---|
| 3N | 0.81 | 3.841 |
| 3S | 0.10 | 3.841 |
| 5 | 2.77 | 3.841 |
| 9C | 1.47 | 3.841 |
| 9E | 1.38 | 3.841 |
| 9W | 0.44 | 3.841 |
| 12 | 11.90 | 3.841 |

As can be seen in Table 3 only the 12th District refutes the Null hypothesis that the probability of an Auxiliarist experiencing interference is the same in that District as it is for the toal of the seven test Districts. Therefore it can be said with a level of confidence of 95% that the probability of an Auxiliarist experiencing interference in the 12th Coast Guard Auxiliary District is higher than the average for all seven

Districts tested. It can also be said that the difference in these two probabilities is larger than that which could be caused by chance under this level of confidence. It must be noted that we have performed multiple tests of the Chi-squared test for proportion in this area. If the degree of confidence is 95%, a statement could be made that in the long run 5 out of very 100 of these tests for significance could be in error.

## 5.3 PROBABILITY OF INTERFERENCE BY NUMBER OF TOWING ASSISTANCE CASES

A total of 5,909 cases of towing assistance were performed by the 800 Auxiliarists interviewed. Of those cases 146 involved interference. Since 5,909 assistance cases were performed by the 800 Auxiliarists interviewed it is reasonable to extrapolate this rate of assistance cases to the target population of 5,137 active Auxiliarists and obtain an estimate of 37,943 towing assistance cases performed by active Auxiliarists in the target districts. Utilizing this information and assuming a confidence level of 96%, equation (3) can be used to estimate the maximum expected error in our sample estimate of percentage of assistance cases during which interference will be experienced. Equation (3) yields:

$$E = \pm Z_{\alpha/2} \sqrt{\frac{\frac{x}{n}\left[1 - \frac{x}{n}\right]}{n}} \cdot \sqrt{\frac{n - n}{n - 1}} \qquad (3)$$

$$E = \pm 2.06 \sqrt{\frac{\frac{146}{5,909}\left[1 - \frac{146}{5,909}\right]}{5,909}} \cdot \sqrt{\frac{37,943 - 5,909}{37,943 - 1}}$$

$$E = \pm 0.00382 \quad \text{or} \quad \pm 0.38\%$$

and $\frac{x}{n} = 146/5,909 = 0.0247$

The percentage of towing assistance cases during which Auxiliarists experienced interference, therefore, is $2.47 \pm 0.38$ percentage points. Extrapolating this to the target population results in the estimate that Auxiliarists in the target Districts experienced interference on 938 towing assistance cases.

The probability of interference being experienced while engaged in the assistance case was analyzed using the Null hypothesis that this probability was equal in all seven target Districts. Table 4 details the results of this Chi-squared test.

TABLE 4: Chi-Squared Test of Proportions
Interference Cases by Towing Assistance Cases

| Null Hypothesis: Probability of interference on an towing assistance case is same in all seven Districts/Region. | | | | | | | |
|---|---|---|---|---|---|---|---|
| District/Region | 3N | 3S | 5 | 9C | 9E | 9W | 12 |
| Observed Frequency of Interference | 39 | 5 | 19 | 18 | 8 | 11 | 46 |
| Expected Frequency by Null Hypothesis | 37.56 | 15.02 | 27.60 | 9.73 | 19.47 | 7.61 | 28.14 |

$\chi^2 = 54.79$ $\chi^2_{.05} = 12.592$ (6 degree of freedom)

As before, the Chi-squared test for proportions indicates that the probability that interference will be experienced on towing assistance cases is not equally distributed amongst all seven

target Districts. To identify those target Districts experiencing higher percentages of interference experienced on assistance cases, Chi-squared tests of proportions were performed for each of the seven Districts using the Null hypothesis that the probability in that district is equal to the overall for all seven districts. Table 5 details the results of these Chi-squared tests.

TABLE 5: Chi-Squared Test Results by District/Region Interference by Towing Assistance Case

| District/Region | $\chi^2$ | $\chi^2$ .05 (df = 1) |
|---|---|---|
| 3N | 0.06 | 3.841 |
| 3S | 6.68 | 3.841 |
| 5 | 2.68 | 3.841 |
| 9C | 7.03 | 3.841 |
| 9E | 6.76 | 3.841 |
| 9W | 1.51 | 3.841 |
| 12 | 11.34 | 3.841 |

As can be seen in the results of Table 5, the Null Hypothesis is rejected in the following Districts: The Third Southern, the Ninth Central, the Ninth Eastern, and the Twelfth Districts. In those four Districts the percentages of towing assistance cases during which interference was experienced is different from the probability of interference being experienced on towing assistance cases for the total seven Districts; the magnitude of this difference is greater than could be expected by chance under a 95% degree of confidence. It should be noted that reference to Table 4 will indicate that the observed frequency of interference on assistance cases is lower than the expected level for the Third Southern and the Ninth Eastern Districts; and higher for the Ninth Central and Twelfth Districts.

## 5.4 ANALYSES OF THE PROBABILITY OF INTERFERENCE

As detailed in the proceeding two sections, a narrowly confined probability of interference has been defined for seven target Districts. This probability indicates that 9.75% of all active Auxiliarists in the target Districts have experienced interference. It also indicates that 2.471% of the towing assistance cases performed by Auxiliarists in the target Districts were marred by interference. Of particular concern in the analysis of this data is the unusual distribution of these interference percentages in the 12th Coast Guard Auxiliary District. It is also interesting to note that when the interference cases are compared with the number of assistance cases performed, three other Districts show unusual distributions of these percentages. The following comparison of assistance caseloads and active Auxiliarists is enlightening:

| District/Region | Active Auxilirists | Assist. Cases | % of Interference |
|---|---|---|---|
| Third Southern | 129 | 608 | 0.8 |
| Ninth Central | 195 | 394 | 4.6 |
| Ninth Eastern | 351 | 788 | 1.0 |
| Twelfth | 255 | 1139 | 4.0 |

Apparently conditions are such in the Third Southern and Ninth Eastern Auxiliary Districts that these Auxiliarists are experiencing interference cases on a smaller percentage of their assistance cases than is the norm. Also, conditions are such towing that Auxiliarists in the Ninth Central and Twelfth Auxiliary Districts are experiencing interference on a substantially higher percentage of their assistance cases than other Coast Guard Auxiliary Districts.

Rash conclusions from the above data cannot be substantiated. The data only reflects the facts experienced by Auxiliarists in those districts and may or may not be a reflection of either the performance of those Auxiliarists or the characteristics of either the waters they boat on or the type of boaters operating in those areas.

## 5.5 INTERFERENCE EXPERIENCED BY TYPE OF AUXILIARY FACILITY

Analysis was made of the type of vessel the Auxiliarist was using as his Facility for both cases where interference was experienced and cases where interference was not experienced. A Chi-squared test of proportions was performed comparing the observed frequency of interference cases by type of facility with the expected frequency indicated by the overall probability of interference. It should be noted that some boat type classifications had to be grouped in order to perform the Chi-squared test with accuracy. Table 6 details this Chi-squared test.

TABLE 6: Chi-Squared Test of Proportions
Auxiliarists Experiencing Interference
by Type of Facility

| Null Hypothesis: Probability of interference is the same for all types of Facilities | | |
|---|---|---|
| Boat Type | Observed Frequency of Interference | Expected Frequency of Interference by Null Hypothesis |
| Open Motorboat | 24 | 21.55 |
| Cabin Motorboat | 50 | 48.75 |
| Other and Not Given | 4 | 7.70 |

$\chi^2 = 2.90$ $\chi^2_{.05} = 5.991$ (2 degrees of freedom)

Since the Null hypothesis in the Chi-squared test of Table 6 was that the probability of experiencing interference was equal for all types of boats, it cannot be said with certainty that that hypothesis had been rejected. It should be noted that the statistical evidence is not there to make a statement that the probability of interference is equal for all types of Auxiliary Facilities. The statistical data only indicates that the Null hypothesis cannot be rejected, it does not prove the Null hypothesis. The one statement that can be said concerning the probability of interference and the type of Facility used by Auxiliarists is that the information does not lend itself to a statistically valid analysis.

## 5.6 SEASON OF INTERFERENCE

Those auxiliarists experiencing interference cases were requested to detail the month in which the interference occurred. The data for the 146 interference cases was collected and tabulated by each of the target districts and as a total. Table 7 details the percentage distribution of interference cases by seasons of the year.

TABLE 7: PERCENTAGE DISTRIBUTION OF INTERFERENCE CASES BY SEASON OF YEAR

| District/Region | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC |
|---|---|---|---|---|
| 3 North | 0 | 13.2 | 86.8 | 0 |
| 3 South | 0 | 40.0 | 60.0 | 0 |
| 5 | 0 | 0 | 94.7 | 5.3 |
| 9 Central | 0 | 5.6 | 94.4 | 0 |
| 9 East | 0 | 25.0 | 75.0 | 0 |
| 9 West | 0 | 36.4 | 54.5 | 9.1 |
| 12 | 2.2 | 46.7 | 48.9 | 2.2 |
| TOTAL | 0.7 | 24.3 | 72.9 | 2.1 |

The distribution indicated in Table 7 shows 97.2 percent of the interference cases occur within the 6 month period from April to September inclusive. For the most part, this distribution holds true for all of the 7 target districts. The larger concentration of the interference cases, however, occurs in the three month period from July thru September inclusive. This percentage distribution tends to coincide with that distribution normally expected for the boating season.

## 5.7 WEATHER CONDITIONS

During the interviewing each Auxiliarist was asked to describe certain weather conditions. Those Auxiliarists who had experienced interference on assistance cases were asked to detail the weather conditions on those cases. Those Auxiliarists who had not experienced interference were asked to detail the weather conditions that most closely typified the conditions of their assistance cases during 1977. Table 8 lists the wind conditions experienced by both groups of Auxiliarists.

TABLE 8: Wind Conditions During Interference

| Cases | WIND FORCE | | | | |
|---|---|---|---|---|---|
| | 0-6 mph | 7-14 mph | 15-25 mph | 25 mph | Unknown |
| Observed Interference | 73 | 28 | 29 | 1 | 15 |
| Typical Case Non-Interference | 399 | 182 | 52 | 1 | 86 |

Mean wind experienced during Interference: 8.53
Sample standard deviation: 7.03
Standard error: 0.61

Mean of typical wind conditions for those Auxiliarists not experiencing interference: 6.58
Sample standard deviation: 5.28
Standard error of mean: 0.21

From the results of Table 8 we can see that the mean or average wind experienced during an interference case was almost 2 mph greater than the wind conditions experienced typically by Auxiliarists who did not experience interference. Since the above information are means established for each of the two samples, there is a probability that the number given will be in error. The relatively large values of the standard deviation for each of the samples does raise some question as to whether the wind for interference cases in actuality higher than the typical wind conditions experienced by Auxiliarists who did not have any interference cases.

In order to test the two values for mean wind speed we can set up a Null hypothesis that the true value for the means of the wind speed are in fact equal. Simply stated, we say that the wind speeds are in fact equal and then see if we have statistically significant information to disprove that statement. To test the difference between these means we use a "t test". A "t test" can be represented by the following equation:

$$t = \frac{\bar{x}_I - \bar{x}_N}{\sqrt{\frac{(n_I - 1) \cdot S_I^2 + (n_N - 1) \cdot S_N^2}{n_I + n_N - 2} \cdot \left[\frac{1}{n_I} + \frac{1}{n_N}\right]}} \qquad (4)$$

where:

$\bar{x}_I$ = mean of interference cases = 8.53

$\bar{x}_N$ = mean of non-interference cases = 6.58

$n_I$ = interference sample size = 131 (146 less unknowns)

$n_N$ = non-interference sample size = 634 (without unknowns)

$S_I^2$ = variance (standard deviation)$^2$ of interference sample = 49.42

$S_N^2$ = variance (standard deviation)$^2$ of non-interference sample = 27.88

$$t = \frac{8.53 - 6.58}{\sqrt{\frac{(131-1)\cdot 49.42 + (634 - 1)\cdot 27.88}{131 + 634 - 2} \cdot \left[\frac{1}{131} + \frac{1}{634}\right]}}$$

$t = +3.617$

however, $t_{.05}$ (95% degree of confidence) = 1.645

Since 3.617 > 1.645, there is a significant difference.

The above calculation indicates that the differnce between the mean wind speed for interference cases and the mean wind speed for non-interference cases is statistically significant. This means that there exists more of a difference between these two means than can logically be attributed to chance; this statement is made with a 95% degree of confidence.

The Auxiliarists interviewed were also requested to classify the conditions of the sky coverage both in interference and non-interference cases. Converting the number of cases into relative percentages allows us to compare the sky conditions for interference cases with the typical sky conditions experienced by those Auxiliarists who did not have any interference cases. Table 9 shows the distribution of these cases both by the number of interference cases under each category and as relative percentages.

TABLE 9: Distribution of Sky Conditions in Percentages

| Conditions | Number of Interference Cases | % of Interference Cases | % of Non-Interference Conditions |
|---|---|---|---|
| Clear | 118 | 80.8 | 69.1 |
| Cloudy | 7 | 4.8 | 11.2 |
| Fog | 1 | 0.7 | 1.5 |
| Rain | 4 | 2.7 | 1.0 |
| Snow | 0 | 0 | 0 |
| Hazy | 1 | 0.7 | 2.2 |
| Unknown | 15 | 10.3 | 15.0 |

Reviewing the percentages in Table 9, they show a considerable amount of difference between interference cases and non-interference conditions. However, comparison of the different percentages does not clearly indicate whether these differences are significant. Does the fact that 80.8% of the interference cases happened in clear conditions really differ that much from 69.1% of the conditions for non-interference? In order to determine if there is a significant amount of difference between these percentages we again make a Null hypothesis and test it with a Chi-squared test. In this case the Null hypothesis is that the distribution of interference cases by sky conditions is in fact equal to the distribution of typical non-interference conditions. The Chi-squared table is constructed by comparing the observed frequencies for interference cases with the expected frequency if the Null hypothesis is correct. Therefore, the 118 interference cases which occurred in clear sky conditions are compared with the 100.89 cases that would be expected under typical conditions experienced by those Auxiliarists who did not have interference cases. The percentages for fog, rain and hazy conditions are combined in order to allow for the size requirements of a Chi-squared test. The results of this Chi-squared test are contained in Table 10.

TABLE 10: Chi-Squared Test of Proportions Sky Conditions for Interference Cases

Null Hypothesis: Distribution of Interference Cases = Distribution of Typical Non-interference Conditions.

| | Clear | Cloudy | Fog/Rain/Hazy | Unknown |
|---|---|---|---|---|
| Observed for Interference | 118 | 7 | 6 | 15 |
| Expected by Null Hypothesis | 100.89 | 16.35 | 6.86 | 21.90 |

$\chi^2 = 10.53$ $\chi^2_{.05} = 7.815$ (df = 3)

In that Chi-squared results are larger than what would be expected (under a 95% degree of confidence) the Null hypothesis can be rejected. Therefore, we can say that the frequency distribution of sky conditions observed during interference cases is significantly different than that typically experienced by Auxiliarists who had no interference cases. We can also say that that difference is sufficiently large that it unlikely to have occurred by chance (in 95 out of 100 cases).

Similar procedures were followed in order to analyze the distribution of interference cases by the type of visibility conditions. Table 11 details this distribution both in numbers of cases and relative percentages. The distribution of non-interference cases are also listed. However, reference to Table 11 also shows that in 38.8% of the non-interference cases the Auxiliarists could not detail what the visibility conditions were. It is not unreasonable to expect that those Auxiliarists experiencing interference could remember the visilibity conditions of a greater degree of accuracy than would Auxiliarists not experiencing interference. This can simply be due to the fact that the interference case would be remembered by the Auxiliarists while cases not involving interference would be more routine and therefore less likely to stand out in memory. Table 11 lists the reported distribution of visibility as a percentage.

TABLE 11: Distribution of Visibility in Percentages

| Conditions | Number of Interference Cases | % of Interference Cases | % of Non-Interference Cases |
|---|---|---|---|
| Good | 116 | 79.5 | 51.8 |
| Fair | 10 | 6.8 | 8.1 |
| Poor | 4 | 2.7 | 0.8 |
| Dark | 1 | 0.7 | 0.6 |
| Unknown | 15 | 10.3 | 38.8 |

If the distribution listed in Table 11 is modified to include only those cases of known visibility the relative percentages are changed considerably. Table 12 illustrates the distribution of known visibility conditions.

TABLE 12: Distribution of Known Visibility

| Conditions | Number of Interference Cases | % of Interference Cases | % of Non-Interference Cases |
|---|---|---|---|
| Good | 116 | 88.5 | 84.6 |
| Fair | 10 | 7.6 | 13.2 |
| Poor | 4 | 3.1 | 1.4 |
| Dark | 1 | 0.8 | 0.9 |

Using the distribution shown in Table 12 a test for significance between the difference in percentages found for interference cases and non-interferences conditions was conducted. Table 13 shows the results of the Chi-squared test for proportions. In Table 13 the null hypothesis used is that the distribution in visibility conditions for interference cases is actually equal to the distribution of visibility conditions for cases typically experienced by Auxiliarists who did not have interference cases.

TABLE 13 Chi-Squared Test of Proportion Known Visibility by Interference Cases

Null Hypothesis: Visibility Distribution of Interference = Non-Interference

| | Good | Fair | Poor/Dark | |
|---|---|---|---|---|
| Observed for Interference | 116 | 10 | 5 | |
| Expected by Null Hypothesis | 110.83 | 17.29 | 3.01 | |

$\chi^2 = 4.63$ $\chi^2_{.05} = 5.991$ (df = 2)

The results of the Chi-squared test in Table 13 indicate that the differences between the visibility conditions experienced by interference cases and that which would be expected if the null hypothesis was true are not large enough to reject the null hypothesis. In other words, there are differences between the two sets but the differences are small enough that they could have occurred by chance using a 95% degree of confidence. Therefore, it cannot be said that these differences are statistically significant. There is not enough statistical evidence to show a significant difference between the visibility distribution of interference cases and that experienced by Auxiliarists not having interference cases. Once again it is important to note that the statistical evidence is not there to state with certainty that the visibility distributions are the same for interference cases and non-interference cases.

The water conditions reported by Auxiliarists interviewed are tabulated for interference cases and non-interference cases. Table 14 lists the water conditions for the number of interference cases, and lists relative percentages for interference cases and non-interference conditions.

TABLE 14: Distribution of Water Conditions in Percentages

| Conditions | Number of Interference Cases | % of Interference Cases | % of Non-Interference Conditions |
|---|---|---|---|
| Calm | 46 | 31.5 | 45.4 |
| Choppy | 56 | 38.4 | 33.3 |
| Rough | 24 | 16.4 | 6.8 |
| Very Rough | 3 | 2.1 | 0.4 |
| Strong Current | 2 | 1.4 | 0.3 |
| Unknown | 15 | 10.3 | 13.9 |

As with the other weather conditions, Chi-squared test of proportions was conducted to test for significant differences in relative percentages. Once again the values compared were those observed during the interference cases and those that would be expected if the distribution of water conditions was the same for both interference and non-interference cases. Therefore, the null hypothesis can be stated as: the distribution of water conditions reported during interference cases is equal to the distribution of typical water conditions experienced by Auxiliarists who did not have interference cases. Table 15 details the results of this Chi-squared test.

TABLE 15: Chi-Squared Test of Proportions
Water Conditions by Interference Cases

| Null Hypothesis: Distribution of Water Conditions for Interference = Non-Interference | | | | |
|---|---|---|---|---|
| | Calm | Choppy | Greater than Choppy | Unknown |
| Observed for Interference | 46 | 56 | 29 | 15 |
| Expected by Null Hypothesis | 66.28 | 48.62 | 10.95 | 20.29 |

$\chi^2 = 38.46 \quad \chi^2_{.05} = 7.815 \ (df = 3)$



Results of the Chi-squared test indicate that the differences in the observed and expected distributions are too great to be accounted for by chance. Therefore, the null hypothesis is rejected and it can be stated that the distribution of water conditions is different during interference cases than the typical conditions for non-interference cases.

During the interviews the Auxiliarists were requested to state the time of day for interference cases and for typical assistance cases when no interference cases had been experienced. The choices allowed on this factor were: dawn, daytime, dusk, night. Relatively large percentages of responses for both interference cases and non-interference cases were coded as unknown in this category. Table 16 depicts the distrubution of time of day conditions in percentages.

TABLE 16: Distribution of Time of Day in Percentages

| Time of Day. | Number of Interference Cases | % of Interference Cases | % of Typical Non-Interference Cases |
|---|---|---|---|
| Dawn | 1 | 0.7 | 0 |
| Day Time | 118 | 80.8 | 59.4 |
| Dusk | 7 | 4.8 | 5.7 |
| Night | 7 | 4.8 | 1.2 |
| Unknown | 13 | 8.9 | 33.7 |

Since there were very few cases that occurred at times other than daytime, other options had to be grouped together to allow a test for significance. The Chi-squared test table and the results of this test are shown in Table 17.

TABLE 17: Chi-Squared Test of Proportions
Known Time of Day by Interference Cases

Null Hypothesis: Distribution of Time of Day for Interference = Non-Interference

| | Day Time | Other | |
|---|---|---|---|
| Observed for Interference | 118 | 15 | |
| Expected by Null Hypothesis | 119.04 | 13.97 | |

$\chi^2 = 0.009$ $\chi^2_{.05} = 3.841$ (df = 1)

The results of this Chi- squared test indicate that there is not enough statistical data to disprove the null hypothesis: that the distribution of interference cases by time of day is the same as the distribution of assistance cases not involving interference. Therefore, the differences between these distributions could be accounted for by chance.

## 5.8 ANALYSIS OF WEATHER CONDITIONS

The preceeding section detailed the statistical analysis of five factors measuring the observed weather conditions on interference cases and typical weather conditions experienced by Auxiliarists who had no interference cases. The above analysis is necessary to set the boundaries for exactly what we can say the collected data indicates. Once this is done a review of the results can be used for a definition of the parameters of the interference problem. For example, the data indicates that the mean wind experienced during interference cases is approximately 2 mph higher than the typical wind conditions experienced by Auxiliarists who did not have interference cases. While it can be shown to a very high degree of confidence that these two means are in fact different, the difference itself may not be meaningful. We have demonstrated that the difference in the two means is statistically significant, but that finding itself may not be significant in a definition of the problem of interference. Wind conditions tabulated are those reported by the Auxiliarists. It is unlikely that a 2 mph difference in wind conditions would (1) be noticed by Auxiliarists, or (2) be of any significant value in defining the interference problem.

The evaluation of the sky coverage leads us to believe that interference cases are occurring in better weather than non-interference cases. A review of Table 9 shows that more of the interference cases occurred during either clear or cloudy conditions than did assistance cases that did not involve interference. This difference could be the result of many factors:

- Glare from windshield or the surface of the water could be causing a disorienting effect.

- Good weather conditions could be causing relaxation or inattention on the part of the boats causing interference.

- A skewing of the data toward good weather conditions might only reflect the fact that more boaters go boating during good weather conditions.

Data obtained from the sky conditions evaluation basically tells us that bad weather is not a factor in interference cases. The analysis of the distribution of the visibility conditions tends to support this. That analysis indicates that there is not enough significant difference between the distributions to show that visibility is a factor in causing interference cases.

Analysis of the water conditions shows an interesting clustering of data. Table 14 shows that more of the interference cases occurred in choppy water conditions (38.4%) than any other water condition classification. Table 14 also shows that 45.4% of the assistance cases that did not result in interference were conducted during calm water conditions. Therefore, the data for water conditions indicates that interference cases are occurring in somewhat rougher water conditions than non-interference cases. The Chi-squared test for this factor also shows that this difference is a statistically significant difference and cannot be discounted by such factors as variance in the samples selected. This

difference becomes quite marked in that almost three times as many cases of interference occurred in very rough waters than would be expected by the typical distribution for water conditions.

The analysis of the time of day factor did not show much difference between interference cases and typical non-interference cases. The data does show that almost 90% of the assistance case workload of the Auxiliary was conducted during daylight hours; and almost 98% of the caseload was conducted between dawn and dusk (using known conditions only).

In summary, it can be stated that the typical interference case will occur under conditions of slightly higher winds and somewhat rougher water conditions. However, visibility and cloud coverage, or precipitation, will not be a factor. It can also be stated that there is no evidence to show that interference cases will occur at different times of day than non-interference assistance cases.

## 5.9 DISTINCTIVE FEATURES

In constructing the questionnaire for the survey consideration was given to the visual display presented by the Auxiliary facility. Did any features of Auxiliary facilities make more them more or less likely to have interference cases? Each Auxiliarist interviewed was requested to detail the distinctive features of his facility. In those instances where the Auxiliarist did not use his own facility but rather crewed for another Auxiliarist, the distinctive features of that facility were documented. In those cases where Auxiliarists predominantly, or entirely, accumulated their patrol hours by crewing, and were involved in interference cases, the distinctive features of the facility used on the interference case were tabulated. In this manner a profile of the distinctive features of Auxiliary facilities that experienced interference could be compared with the profile of facilities of those Auxiliarists who experienced no interference.

A contingency table of these distinctive features was constructed. The Null hypothesis used in the contingency table was that the occurrence of interference is in fact independent of distinctive features. Table 18 shows the contingency table detailing the results of the testing of the Null hypothesis.

TABLE 18: Contingency Table of Distinctive Features

| Features | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Flying Bridge | 18 | 180 |
| Bright Color Scheme | 17 | 99 |
| Unusual Markings | 1 | 15 |
| Other | 8 | 47 |

Null Hypothesis: Interference is Independent of Features

$\chi^2 = 3.21$ $\chi^2_{.05} = 7.815$ (df = 3)

The results of the test of the contingency table indicate that the differences in distinctive features between Auxiliarists experiencing interference and Auxiliarists experiencing no interference are not statistically significant. Therefore, the Null hypothesis (that interference is independent of features) cannot be rejected within the 95% degree of confidence. Once again it must be noted that the results of the test cannot prove the null hypothesis; it just proves that the Null hypothesis cannot be rejected based on this data.

The analysis of this data therefore indicates no justification that an Auxiliarist's use of a distinctive feature would tend to lead to or avoid the occurrence of interference.

## 5.10 ADDITIONAL GEAR CARRIED

Another point of consideration was whether or not any particular item of gear carried on board the Auxiliary Facility would be useful in avoiding interference. Each Auxiliarist interviewed indicated whether or not the following gear was carried on board his Facility: bullhorn, spotlight, patrol signboards, special lights (including rotating or flashing lights), and any other gear which could be used to draw attention to his Facility. Table 19 lists the number of Auxiliarists carrying the respective pieces of gear tabulated for both those Auxiliarists experiencing interference and those experiencing no interference. The contingency table is constructed to test the independence of the type of gear carried and whether or not the Auxiliarist experienced interference. The Null hypothesis can then be stated as: The occurrence of interference is independent of the type of gear carried aboard the Facility. Table 19 contains the results of that test.

TABLE 19: Contingency Table of Additional Gear

| Gear Carried | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Bullhorn | 62 | 547 |
| Spotlights | 74 | 666 |
| Patrol Signs | 74 | 665 |
| Special Lights | 12 | 76 |
| Other | 10 | 90 |

Null Hypothesis: Interference is Independent of Gear Carried

$\chi^2 = 1.20$ $\chi^2_{.05} = 9.488$ (df = 4)

The results of the testing for the above contingency table indicate that the relative differences between Auxiliarists experiencing interference and those experiencing no interference are not large enough to be considered statistically valid. Therefore, the Null hypothesis (that the occurrence of interference is independent of gear carried) cannot be rejected at the degree of confidence of 95%. There is no statistical proof that there is any relationship between type of gear carried and whether or not an Auxiliarist will experience interference. On the other hand, the same restriction must apply as before, that the data tested does not prove the Null hypothesis. It simply indicates that there is not enough proof to disprove it.

Analysis of the above data indicates that there is no reason shown to believe that the carrying of any the items of equipment listed above on any Auxiliary Facility had any relation to causing or preventing interference.

## 5.11 RESULTING DAMAGE CAUSED BY INTERFERENCE

Those Auxiliarists interviewed reporting experiencing interference cases were questioned as to whether that interference resulted in damage to their Facility, to the vessel being towed, or any gear (such as a towing rig). No report of personal injury was made. In 43 of the cases the Auxiliarists reported that interference resulted in damage. In all of those 43 cases, however, the estimate of the damage was less than $50. Considering the 146 cases as the sample size, the 43 cases that resulted in damage as the observed value, and an extrapolated value of 938 interference cases for all seven target Auxiliary Districts, an estimate of the maximum expected error and the probability that interference will result in damage can be made. Equation (3), which was used above, is again utilized to estimate the maximum expected error (E):

$$E = Z_{\alpha/2} \sqrt{\frac{\frac{x}{n} \cdot \left[1 - \frac{x}{n}\right]}{n}} \cdot \sqrt{\frac{n - n}{n - 1}} \qquad (3)$$

$n$ = 146 interference cases

$x$ = 43 cases resulting in damages

$\alpha$ = 0.04 confidence factor

$Z_{\alpha/2}$ = 2.06 - standard unit measure

$N$ = 938 extrapolated interference cases

$$E = \pm\sqrt{\frac{\frac{43}{146}\left[1 - \frac{43}{146}\right]}{146}} \cdot \sqrt{\frac{938 - 146}{939 - 1}} \qquad (3)$$

$$E = \pm 0.0714$$

$\frac{x}{n}$ = 2.2945 = probability that an interference case will result in damage.

We can now state that the probability that an interference case will result in damage is 29.45%. At a confidence level of 96% we can state that the most our estimate will be off will be 7.14 percentage points. Using this data, and the fact that each of the 43 interference cases resulted in no more than $50, we can now state at a confidence level of 96% that the total damage resulting from interference in 1977 in the seven target Auxiliary Districts, at the most was between $10,461.98 and $17,648.99.

## 5.12 PATROL HOURS

Each Auxiliarist interviewed was requested to verify the number of hours spent on patrol as skipper or crew. The responses were then tabulated in a contingency table according to patrol hours groupings and whether or not the Auxiliarists had experienced interference. This contingency table is shown in Table 20.

TABLE 20: Contingency Table of Patrol Hours

| Patrol Hours Performed By Auxiliarist in 1977 | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Less than 21 | 10 | 139 |
| 12 to 50 | 23 | 296 |
| 51 to 100 | 23 | 189 |
| 101 to 200 | 10 | 73 |
| More than 200 | 11 | 24 |

Null Hypothesis: Interference Is Independent of Patrol Hours

$\chi^2 = 23.59$ $\chi^2_{.05} = 9.488$ (df = 4)

The contingency table for patrol hours was tested using the Null hypothesis that the occurrence of interference acts independently of the number of patrol hours conducted during 1977. The results of this test reject the Null hypothesis showing that there is a definite relationship between the number of patrol hours performed by Auxiliarists and whether or not they have experienced interference. The data listed in Table 20 shows that the differences between Auxiliarists who have experienced interference and those who have not experienced interference changes as the number of patrol hours accumulated increases. This difference grows greater in magnitude (relatively) as patrol hours approach 200 and then exceed it. The contingency table results indicate that these differences are more than what could be experienced by chance at a 95% degree of confidence.

In order to determine whether or not these differences occurred in each of the Districts studied individual contingency table tests were run for each of the target districts. These contingency table results are shown in Table 21.

TABLE 21: Contingency Table Results of Patrol Hours by District/Region

| District | $\chi^2$ | $\chi^2_{.05}$ |
|---|---|---|
| 3N | 3.32 | 9.488 |
| 3S | 3.47 | 9.488 |
| 5 | 3.62 | 9.488 |
| 9C | 14.28 | 9.488 |
| 9E | 6.75 | 9.488 |
| 9W | 7.33 | 9.488 |
| 12 | 18.62 | 9.488 |

The results of these statistical significance tests indicate that in the Ninth Central and Twelfth Coast Guard Auxiliary Districts there are statistically significant differences for the patrol hours of Auxiliarists who experienced interference when compared with the patrol hours of Auxiliarists who have not experienced interference. A closer review of the percentage distribution of patrol hour categories for these two Districts is shown in Table 22.

TABLE 22: Patrol Hours Distribution by Percentage for District 9C and 12

| Patrol Hours | District 9C | | District 12 | |
|---|---|---|---|---|
| | Interf. | Non-Inter. | Interf. | Non-Inter |
| Less than 21 | 33.3 | 16.7 | 0 | 1.4 |
| 21 to 50 | 0 | 51.7 | 15.8 | 35.2 |
| 51 to 100 | 33.3 | 23.3 | 42.1 | 38.0 |
| 101 to 200 | 22.2 | 8.3 | 5.3 | 21.1 |
| More than 200 | 11.1 | 0 | 36.8 | 4.2 |

An analysis of the percentage distribution of patrol hours accumulated by Auxiliarists and whether or not interference occurred shows similar differences for both Districts. In both Districts Auxiliarists who have experienced interference tend to be grouped toward the larger number of patrol hours accumulated. The distribution of patrol hours of Auxiliarists who have not experienced interference tends to be grouped more toward the lower hour totals. What the distribution of this data does not show, however, are the reasons for this difference. This data could indicate that as Auxiliarists spend more hours on patrol they tend to relax more and this reduction in caution could be causing interference cases. However, it is equally probable, based on this data, to hypothesize that the longer an Auxiliarist patrols the more likely he is to experience a situation where another boater will cause interference. What can be said from an analysis of this data, is that as an Auxiliarist patrols (either as skipper or crew) for more hours, especially over 50 hours, that Auxiliarist will be more likely to experience interference. This holds true for the Ninth Central and Twelfth Coast Guard Auxiliary Districts. The data does not show such a relationship for the other five Coast Guard Auxiliary Districts tested. In those five Districts, the differences between the distribution of patrol hours are not great enough to show a distinct relationship between the hours of patrol work and the probability of experiencing interference.

### 5.13 NUMBER OF ASSISTANCE CASES PERFORMED

The total number of assistance cases (both those involving towing and those not involving towing) were recorded for each Auxiliarist. The number of assistance cases were then tabulated according to the groupings shown in Table 23 for those Auxiliarists experiencing interference and those Auxiliarists experiencing no interference.

TABLE 23: Contingency Table of Number of Assistance Cases Performed

| Number of Assistance Cases Performed in 1977 | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Less than 5 | 19 | 349 |
| 6 to 10 | 17 | 171 |
| 11 to 20 | 16 | 127 |
| More than 20 | 26 | 74 |

Null Hypothesis: Interference Is Independent of the Number of Assistance Cases Performed.

$\chi^2 = 39.21$ $\chi^2_{.05} = 7.815$ (df = 3)

The analysis of the statistical significance of the results of this contingency table refute the Null hypothesis that the occurrence of interference is independent of the number of assistance cases performed. The results of these tests were then compared on a District by District bases. The results of these contingency table tests are shown in Table 24.

TABLE 24: Contingency Table Results of Number of Assistance Cases By District

| District/Region | $\chi^2$ | $\chi^2_{.05}$ |
|---|---|---|
| 3N | 15.32 | 7.815 |
| 3S | 33.83 | 7.815 |
| 5 | 13.40 | 7.815 |
| 9C | 3.55 | 7.815 |
| 9E | 2.99 | 7.815 |
| 9W | 3.33 | 7.815 |
| 12 | 23.55 | 7.815 |

The review of these results indicate that the Null hypothesis is rejected for the following: The Third Northern, the Third Southern, the Fifth and the Twelfth Coast Guard Auxiliary Districts. Table 24 shows that the differences in the Ninth Central, Ninth Eastern and Ninth Western Coast Guard Auxiliary Districts are not statistically significant enough to refute the Null hypothesis. In these three Districts, there is not enough statistical evidence to say that the relationship between interference and the number of assistance cases performed is not independent.

A closer look at the percentage distribution of assistance cases for Auxiliarists who have experienced interference and those who have not is shown in Table 25 and 26 for those four target Districts showing significance. Table 25 shows the percentage distributions for the Third Northern and Third Southern Coast Guard Auxiliary Districts. Table 26 shows the percentage differences for the Fifth and Twelfth Districts.

TABLE 25: Number of Assistance Cases By Percentage Distribution For Districts 3N and 3S

| Assistance Cases Per Auxiliarist | District 3N | | District 3S | |
|---|---|---|---|---|
| | Interf. | Non-Interf. | Interf. | Non-Inter. |
| Less than 5 | 12.1 | 11.3 | 14.3 | 1.8 |
| 6 to 10 | 6.1 | 15.1 | 0 | 4.4 |
| 11 to 20 | 60.6 | 30.2 | 85.7 | 15.3 |
| More than 20 | 21.2 | 43.4 | 0 | 78.5 |

TABLE 26: Number of Assistance Cases by Percentage Distribution for Districts 5 and 12

| Assistance Cases Per Auxiliarist | District 5 | | District 12 | |
|---|---|---|---|---|
| | Interf. | Non-Interf. | Interf. | Non-Interf. |
| Less than 5 | 18.2 | 17.3 | 10.4 | 4.0 |
| 6 to 10 | 45.5 | 21.3 | 4.2 | 12.2 |
| 11 to 20 | 31.8 | 22.3 | 35.4 | 14.4 |
| More than 20 | 4.5 | 39.0 | 50.0 | 69.4 |

Table 25 indicates a relatively large percentage of those Auxiliarists who have experienced interference grouped in the 11 to 20 assistance case category. Table 26 shows somewhat the same grouping for the Fifth and Twelfth Districts. However, in the Fifth District this concentration spills over to the 6 to 10 assistance case grouping; and the Twelfth District spills over to the more than 20 category.

In the analysis of this data we can say that there is a relationship between the number of assistance cases performed and the probability of experiencing interference in the following Districts: The Third Northern, the Third Sourthern, the Fifth, and the Twelfth Coast Guard Auxiliary Districts.

As with the analysis of the patrol hours, concentrations of those Auxiliarists experiencing interference tend toward the higher category of assistance cases. Each of the four Districts studied show high concentrations of Auxiliarists experiencing interference in the 11 to 20 case groupings. These concentrations spill over somewhat to neighboring groupings especially in the Fifth and Twelfth Coast Guard Districts. Once again, the cause of these distribution is not known. As with the number of patrol hours, the cause for these distributions could be:

- The more assistance cases you perform, the more relaxed your attention.

- The more assistance cases you perform, the more likely you are to run across someone who will eventually cause interference.

What can be said is that in the Third Northern, Third Southern, Fifth, and Twelfth Coast Guard Auxiliary Districts active Auxiliarists are experiencing interference as the number of assistance cases they perform increases.

## 5.14 CARRYING OF SPECIAL LIGHTS

As indicated earlier in this report, the authorization of a flashing light for use by Coast Guard Auxiliarists has been a biasing factor in the conduct of this project. Due to the importance placed upon this proposed solution, a question was included in the survey as to whether or not Auxiliarists were carrying a special light. Two biasing factors tended to counteract each other:

- The Auxiliarists knew that the light was illegal, and were therefore hesitant to report its use.

- The Auxiliarists were eager for authorization of the flashing light, and were therefore eager to document its use and the effectiveness.

While these two factors did not play a role in each and every survey performed, they were present in a good proportion of the interviews. The amount of bias, of course, varied from Auxiliarist to Auxiliarist; and only in a very few cases overrode the desire to provide reliable data.

Because of the critical role played by this proposed solution, a special analysis was performed comparing the carrying of this special piece of gear between Auxiliarists who experienced interference and those who experienced no interference. Table 27 details the tabulation of this data and tests the Null hypothesis that interference occurs independently of the carrying of special lights.

Table 27: Contingency Table of Special Lights

| Gear Carried By Auxiliarist | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Special Lights Not Carried | 66 | 623 |
| Special Lights Carried | 12 | 76 |
| Lights Carried Unknown | 0 | 22 |

Null Hypothesis: Interference Is Independent of Special Lights Carried

$\chi^2 = 3.91$ $\chi^2_{.05} = 5.991$ (df = 2)

Analysis of the data contained in the contingency table shown in Table 27 indicates that the distribution differences between Auxiliarists experiencing interference and those experiencing no interference is not strong enough to refute the Null hypothesis. Therefore, at the selected level of confidence (95%) the data collected does not disprove the hypothesis that interference will happen whether or not the Auxiliarist is carrying a special light.

## 5.15 INFLUENCE OF TRAINING

An analysis was made of the influence of training received by the Auxiliarist and the occurrance of interference. The first step was to compare the status of Auxiliarists. The Auxiliarists surveyed were from two groups of membership. Basically Qualified (BQ) and Operational Member (AUXOP). As the title suggests, a BQ member has received training on many operational areas which qualifies him or her to perform many of the basic operations of the Auxiliary. The training course encompasses both text book instruction and practical demonstrations. The areas covered by the training include such topics as Seamanship and the Rules of the Road.

Once a member is BQed, a curriculum of seven specialized courses are available. These courses cover:

- Search and Resource
- Communications
- Patrol Procedures
- Weather
- Seamanship
- Piloting, and
- Administration.

Each of these courses are quite detailed and cover the subject area extensively. In order to be considered a "specialist" in any of these areas, the Auxiliarist must pass a comprehensive written examination, and in most of the courses satisfactorily demonstrate skill through a series of prescribed practical demonstrations.

The Auxiliarist who has satisfactorily completed all seven speciality courses, (including demonstrations) is awarded the distinction of being an Operational Member (AUXOP). In the earlier stages of the Auxiliary's history, there was a consolidated procedure for obtaining AUXOP status. This procedure was terminated

many years ago, but some of the Auxiliarists surveyed had qualified as AUXOP under the old procedure.

The first analysis made was whether or not BQed members were more or less likely to experience interference than AUXOP members. The Auxiliarists surveyed were tabulated by membership status and whether or not they had experienced interference. This contingency table is shown in Table 28.

Table 28: Contingency Table of Member Status

| Membership Status | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| BQ | 69 | 652 |
| AUXOP | 9 | 70 |

Null Hypothesis: Interference is Independent of Membership Status

$$\chi^2 = 0.27 \qquad \chi^2_{.05} = 3.841 \text{ (df = 1)}$$

The contingency table for Membership Status was tested using the Null hypothesis that interference will occur regardless of the Membership Status of the Auxiliarist performing the patrol. The results of this test indicate that the Null hypothesis cannot be rejected. Therefore, at a 95% degree of confidence, we can say that there is no evidence to indicate that the Membership Status (training) of the Auxiliarist has any effect on the occurrence of interference.

## 5.16 SPECIALTY COURSES

In a like manner, the relationship of the Specialty Training Courses and the occurrence of interference were investigated. The two training courses which most directly relate to an interference situation are the Search and Rescue and Seamanship Courses.

Contingency tables were constructed for each of these courses comparing those Auxiliarists who had taken those courses with those who had not, and whether or not they had experienced interference. These tables are shown in Tables 29 and 30.

Table 29: Contingency Table of SAR Course

| | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Aux. taken SAR | 23 | 229 |
| Aux. not taken SAR | 55 | 493 |

Null Hypothesis: Interference is Independent of SAR Training

$\chi^2 = 0.16$ $\chi^2_{.05} = 3.841$ (df = 1)

The Null hypothesis used for this test was that an Auxiliarist who had completed the SAR course was just as likely to experience interference as an Auxiliarist who had not taken the course. All of the AUXOP members were considered to have completed the SAR course. The results of the test indicate that the Null hypothesis cannot be rejected. We can say, at a 95% degree of confidence, that the data does not support the supposition that completion of the SAR course will deminish the probability of interference.

Table 30: Contingency Table of Seamanship Course

| | Aux. Experiencing Interference | Aux. Experiencing No Interference |
|---|---|---|
| Aux. taken Seamanship | 32 | 223 |
| Aux. not taken Seamanship | 46 | 499 |

Null Hypothesis: Interference is Independent of Seamanship Training

$$\chi^2 = 3.33 \qquad \chi^2_{.05} = 3.841 \ (df = 1)$$

The Null hypothesis used in this test was that an Auxiliarist who has completed the Seamanship Specialty Course is as likely to experience interference as one who has not. The results of the test show that we cannot reject the Null hypothesis at a 95% degree of confidence. Therefore, we can say that the data does not support the hypothesis that completion of the Seamanship Course will reduce the likelihood of interference.

## 5.17 ANALYSIS OF TRAINING DATA

The above analyses show very little indication that the training an Auxiliarist received had any affect on the occurrence of interference. It should be noted that the training received by Auxiliarists does not have any direct mention of the interference problem. This is a relatively recent problem and therefore has not been addressed specifically in these courses. What the analysis does seem to support is the supposition that interference happens independently of the actions and training of the Auxiliarist.

TABLE 31 : District by District Comparison of Factors

| Factor Considered | District/Region | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | 3N | 3S | 5 | 9C | 9E | 9W | 12 | |
| Probability that interference will be experienced by an active Auxiliarist (%) | 7.73 | 8.33 | 6.06 | 14.29 | 6.45 | 12.16 | 21.11 | 9.75 |
| Probability that interference will be experienced on a towing assistance case (%) | 2.57 | 0.82 | 1.70 | 4.57 | 1.02 | 3.57 | 4.04 | 2.47 |
| Analysis of type of Facility vs. interference | NO STATISTICAL SIGNIFICANCE | | | | | | | |
| Percentage distribution of interference cases by season (%): | | | | | | | | |
| Jan. - Mar. | 0 | 0 | 0 | 0 | 0 | 0 | 2.2 | 0.7 |
| Apr. - Jun. | 13.2 | 40.0 | 0 | 5.6 | 25.0 | 36.4 | 46.7 | 24.3 |
| Jul. - Sep. | 86.8 | 60.0 | 94.7 | 94.4 | 75.0 | 54.5 | 48.7 | 72.9 |
| Oct. - Dec. | 0 | 0 | 5.3 | 0 | 0 | 9.1 | 2.2 | 2.1 |

TABLE 31: District by District Comparison of Factors (Cont.)

| Factor Considered | District/Region | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | 3N | 3S | 5 | 9C | 9E | 9W | 12 | |
| Weather Conditions: | | | | | | | | |
| Wind | STATISTICALLY SIGNIFICANT DIFFERENCE BUT ONLY 2 MPH IN MAGNITUDE | | | | | | | |
| Sky | STATISTICALLY SIGNIFICANT DIFFERENCE: TENDS TO BE CLEARER | | | | | | | |
| Visibility | NO STATISTICAL SIGNIFICANCE | | | | | | | |
| Water Conditions | STATISTICALLY SIGNIFICANT DIFFERENCE: TENDS TO BE ROUGHER | | | | | | | |
| Time of Day | NO STATISTICAL SIGNIFICANCE | | | | | | | |
| Distinctive Features | NO STATISTICAL SIGNIFICANCE | | | | | | | |
| Additional Gear | NO STATISTICAL SIGNIFICANCE | | | | | | | |
| Probability that interference will result in damage (%) | 2.56 | 0 | 0 | 22.22 | 0 | 45.45 | 71.74 | 29.45 |

TABLE 31: District by District Comparison of Factors (Cont.)

| Factor Considered | District/Region | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | 3N | 3S | 5 | 9C | 9E | 9W | 12 | |
| Patrol Hours :<br>S = Significant Difference<br>N = No Statistical Significance | N | N | N | S | N | N | S | S |
| # of Assistance Cases<br>S = Significant Difference<br>N = No Statistical Significance | S | S | S | N | N | N | S | S |
| Use of Special Lights | No Statistical Significance | | | | | | | |
| Training: | | | | | | | | |
| BQ/AUXOP | No Statistical Significance | | | | | | | |
| SAR | No Statistical Significance | | | | | | | |
| Seamanship | No Statistical Significance | | | | | | | |

TABLE 32: Exposure Data By District

| | District/Region | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
| Number of Active Auxiliarists (August 1977) | 557 | 129 | 564 | 195 | 351 | 211 | 255 | 2,262 |
| Number in Sample | 196 | 48 | 198 | 70 | 124 | 74 | 90 | 800 |
| Number of Patrol Hours | 11,376 | 3,284 | 13,746 | 4,636 | 10,431 | 3,450 | 8,795 | 55,851 |
| Number of Assistance Cases | 2,100 | 1,708 | 1,617 | 608 | 1,334 | 533 | 1,620 | 9,557 |
| Patrol Hours/Auxiliarist | 58.64 | 68.42 | 69.42 | 66.23 | 84.12 | 46.62 | 97.72 | 69.81 |
| Assistance Cases/Auxiliarist | 10.82 | 35.58 | 8.17 | 8.69 | 10.76 | 7.20 | 18.00 | 11.95 |
| Probability of Interference by Auxiliarist (%) | 7.73 | 8.33 | 6.06 | 14.29 | 6.45 | 12.16 | 21.11 | 9.75 |
| Probability of Interference by Assistance Case (%) (all cases) | 1.86 | 0.29 | 1.18 | 2.96 | 0.60 | 2.06 | 2.84 | 1.53 |

## 6.0 END OF YEAR COMPARISON OF SAMPLE DATA

The AUXMIS listing of "active" Auxiliarists in the target districts was compiled in September 1977. In effect, that printout listed the Auxiliarists who had completed nine or more hours of patrol work by that date. Certain system delays in the reporting procedures made the effective cut off date for that tabulation August 1977. A second count of "active" Auxiliarists was performed using total year patrol figures for 1977. The results of that tabulation are shown in Table 33.

TABLE 33: Patrol Data for Total 1977
Active Auxiliarists

| District or Region | Greater than 9 Hours | Target District as of September 1977 |
|---|---|---|
| First | 527 | - |
| Second, Eastern | 325 | - |
| Second, Northern | 291 | - |
| Second, Southern | 192 | - |
| Second, Western | 262 | - |
| Third, Northern | 1,331 | 557 |
| Third, Southern | 308 | 129 |
| Fifth | 1,251 | 564 |
| Seventh | 1,298 | - |
| Eighth | 796 | - |
| Ninth, Central | 467 | 195 |
| Ninth, Eastern | 664 | 351 |
| Ninth, Western | 490 | 211 |
| Eleventh | 725 | - |
| Twelfth | 626 | 255 |
| Thirteenth | 620 | - |
| Fourteenth | 89 | - |
| Seventeenth | 56 | - |
| Total | 10,318 | 2,262 |

Comparison between the two printouts indicates that 44.0% of the total year "active" Auxiliarists in the target districts were included in the printout used for the survey. The percentage of "active" Auxiliarists contained in the first printout remains fairly constant for all the target districts (between 40 and 45%) with the exception of the Ninth Eastern where 52.9% of the "active" Auxiliarists were captured in the first printout.

A comparison test for the two printouts was performed. The maximum expected error (E) in the probability that an "active" Auxiliarist would experience interference was studied. The target population of the first printout was used to calculate E and then compared with the value of E based upon the number of "active" Auxiliarists at the end of 1977. Using 2,262 as $N_1$ (the target population as of September 1977) and 5,137 as $N_2$ (the target population as of December 1977) Equation (3) was solved for E.

$$E = \pm Z_{\alpha/2} \sqrt{\frac{\frac{x}{n}\left[1 - \frac{x}{n}\right]}{n}} \cdot \sqrt{\frac{N - n}{N - 1}} \qquad (3)$$

where:

$x = 78$

$n = 800$

$N_1 = 2,262$

$N_2 = 5,137$

$Z_{\alpha/2} = 2.06$

$$E_1 = \pm 2.06 \sqrt{\frac{\frac{78}{800}\left[1 - \frac{78}{800}\right]}{800}} \cdot \sqrt{\frac{2,262 - 800}{2,262 - 1}} \qquad (3)$$

$E_1 = \pm .0174$ or $\pm 1.74\%$ for September 1977 printout

$$E_2 = \pm 2.06 \sqrt{\frac{\frac{78}{800}\left[1 - \frac{78}{800}\right]}{800}} \cdot \sqrt{\frac{5,137 - 800}{5,137 - 1}} \qquad (3)$$

$E_2 = \pm .0199$ or $\pm 1.99\%$ for End of 1977 printout

This result shows that using the September 1977 printout data would have lead us to believe our resultant probability of interference was within $\pm$ 1.74 percentage points; however, the actual range of error was $\pm$ 1.995 percentage points. Therefore, the actual range of the maximum expected error is $\pm$ 0.25% greater than would be expected from the data available in September 1977.

Another way of expressing this difference is by the Degree of Confidence measure. Based upon the target population calculated in September 1977 it was calculated that the maximum expected error was $\pm$ 0.0174 and that was associated with a Degree of Confidence of 96%. The same maximum error could be defined for the target population as of the end of the year, but the Degree of Confidence would be only 92.8%. This decrease of 3.2% in the Degree of Confidence reflects the fact that the target population was larger than originally suspected and therefore our sample size constitutes a relatively smaller proportion of the true target population of "active" Auxiliarists.

It is important to note that even the "decreased" Degree of Confidence of 92.8% is still very high. What has been demonstrated is the fact that even though the September 1977 printout only represented 44.0% of the actual number of "active"Auxiliarists, the size of the sample was still large enough to produce a high degree of confidence.

The "corrected" values for the target population as represented by the end of year printout were used throughout this report for extrapolation within the target districts.

## 7.0 EXTRAPOLATION OF SAMPLE RESULTS

In order to formulate a national picture of the problem of interference a two step extrapolation process was used. The first step involved expanding the sample data to the total population in the target districts. Since the sample was randomly selected

this process became a direct conversion of the proportions discovered in the sample to the total population of "active" Auxiliarists in those districts. The second step was a classification of the target districts to allow comparison with the non target districts. As shown in the earlier section discussing Patrol Hours, there was a correlation shown between interference and the number of hours patrolled in two target districts. These districts were the Ninth Central and Twelfth Districts.

In that contingency table (TABLE 21) there was not sufficient statistical significance to refute the Null Hypothesis for the other five target districts. There is a chance of making a "Type II error" if we assume that the Null Hypothesis is correct in those five districts. That Null Hypothesis was that the fact that an Auxiliarist experiences interference acts independently of the number of hours he or she patrols. However, we can reject the two districts for which the Null Hypothesis was disproved from further testing. We can show, at a statistically significant level that Auxiliarists (in those two districts) who have experienced interference have different levels of patrol work than those Auxiliarists who did not experience interference.

If we accept the risk of a "Type II error" (accepting a hypothesis when it may be false) we can make the assumption that, in at least the five remaining target districts, the patrol hour distributions are the same for those Auxiliarists who have experienced interference and those who have not. After making that assumption, the probability that an Auxiliarist will experience interference can be calculated for each of the patrol hour groupings. The resulting probabilities are listed below:

| | |
|---|---|
| less than 50 hours: | 6.84% |
| 50 to 100 hours: | 7.50% |
| 101 to 200 hours: | 11.67% |
| over 200 hours: | 12.50% |

The breakdown of "active" Auxiliarists according to the number of hours patrolled by the end of 1977 was provided by Coast Guard Headquarters. TABLE 34 on the following page presents that data. The data listed in this table can be condensed to the following totals for the non target districts:

| | |
|---|---|
| less than 50 hours: | 3,532 Auxiliarists |
| 50 to 100 hours: | 1,080 Auxiliarists |
| 101 to 200 hours: | 441 Auxiliarists |
| over 200 hours: | 128 Auxiliarists |

By applying the probabilities calculated for each of the patrol hour groupings listed above, the number of Auxiliarists experiencing interference in the non target districts can be estimated. This estimate results in 390 Auxiliarists experiencing interference in the non target districts. The number (extrapolated) of Auxiliarists experiencing interference in the target districts was calculated to be 506. Therefore, it can be estimated that 896 "active" Auxiliarists have experienced interference nationwide during 1977. Since the target districts were the ones from which most complaints had been received it would be logical to assume that the 896 Auxiliarists figure represents the upper boundry of the interference problem.

Similar procedures were followed to determine the number of cases of interference in 1977 on a national basis. In the analysis of assistance cases performed by the sample Auxiliarists, it was shown that there was a correlation between the occurrence of interference and the number of assistance cases in four of the districts. Those districts were: the Third Northern, the Third Southern, the Fifth, and the Twelfth districts. If we again take the risk of making a "Type II error" we can make the assumption that the Auxiliarists in the three Regions of the Ninth District have the same distribution of assistance cases whether or not they have experienced interference. We can then calculate the probability that an "active"Auxiliarist (in the Ninth District) will

TABLE 34: YEAR END (1977) PATROL HOURS DATA

| District or Region | "ACTIVE" AUXILIARISTS Participating | | | | Total Over 10 Hours |
|---|---|---|---|---|---|
| | 10-50 Hours | 51-100 Hours | 101-200 Hours | 201 & Up Hours | |
| 1 | 417 | 81 | 24 | 5 | 527 |
| 2E | 197 | 75 | 42 | 11 | 325 |
| 2N | 188 | 55 | 31 | 17 | 291 |
| 2S | 144 | 34 | 12 | 2 | 192 |
| 2W | 169 | 59 | 28 | 6 | 262 |
| 3N | 1,025 | 221 | 65 | 20 | 1,331 |
| 3S | 215 | 66 | 17 | 10 | 308 |
| 5 | 888 | 252 | 87 | 24 | 1,251 |
| 7 | 941 | 254 | 85 | 18 | 1,298 |
| 8 | 452 | 245 | 85 | 14 | 796 |
| 9C | 322 | 98 | 40 | 7 | 467 |
| 9E | 444 | 133 | 61 | 26 | 664 |
| 9W | 330 | 104 | 38 | 18 | 490 |
| 11 | 478 | 138 | 81 | 28 | 725 |
| 12 | 359 | 145 | 96 | 26 | 626 |
| 13 | 477 | 110 | 28 | 5 | 620 |
| 14 | 58 | 14 | 8 | 9 | 89 |
| 17 | 11 | 15 | 17 | 13 | 56 |
| TOTAL ACTIVE | | | | | 10,318 |

experienced interference while on an assistance case. Since interference was experienced on 37 of the 1,526 towing assistance cases performed in 1977 by this portion of the sample, the probability is 2.37% that an Auxiliarist from that sample experienced interference on an assistance case. There were 268 "active" Auxiliarists sampled in those regions who performed an average of 5.82 towing assistance cases each. Since there were 5,181 year end (1977) "active" Auxiliarists in the non target districts, we can extrapolate that they would have performed 30,153 towing assistance cases during 1977. By applying the probability calculated above we can determine that interference marred 715 of those cases.

By applying the extrapolated number of towing assistance cases to the total probabilities of interference for all of the target districts we can determine the number of expected interference cases.

| | |
|---|---|
| Extrapolated "active" Auxiliarists: | 5,137 |
| Extrapolated towing assistance cases: | 37,943 |
| Probability of Interference: | 2.47% |
| Extrapolated Interference cases: | 938 |

Therefore, we can make an estimate that 1,653 cases of interference occurred nationwide in 1977. Once again the selection criteria of the target districts leads us to believe this is an upper boundry on the interference problem.

Since only 43 cases out of 5,909 towing assistance cases performed by the sample resulted in damage due to interference, a total sample probability was used as opposed to district probabilities. The probability that an interference case would result in damage was 29.45%. Applying this to the 1,653 nation wide interference cases results in 487 interference cases involving damage. Since the sample cases never resulted in damage of more than $50.00 we can use this as an upper limit on the cost of interference in 1977 to result in no more than $24,342 in damage. As before, this represents the upper boundry and we would expect the actual figure to be much less.

## 8.0 COMPARISON WITH OTHER YEARS

During the interviews the investigators would occasionally be told that 1977 was a slow year; and that 1976 was a much more active year. To confirm or refute this premise past year data was compared for the target districts. TABLE 35 shows the number of reported assistance cases for the target districts for 1976 and 1977.

TABLE 35: 1976 AND 1977 REPORTED ASSISTANCE CASES FOR TARGET DISTRICTS/REGIONS

| District | 1976 | 1977 | % Change from 1976 |
|---|---|---|---|
| 3N | 2,997 | 2,733 | -8.8 |
| 3S | 1,167 | 1,308 | +12.1 |
| 5 | 1,386 | 1,827 | +31.8 |
| 9C | 596 | 749 | +25.7 |
| 9E | 1,089 | 1,173 | +7.7 |
| 9W | 584 | 447 | -23.5 |
| 12 | 1,503 | 1,062 | -29.3 |
| TOTALS | 9,322 | 9,299 | -0.2 |

As can be seen there were dramatic decreases in reported activity in the Ninth Western and Twelfth districts. There was a significant decrease in the Third Southern District. There were offsetting increases in the other four districts, however. The districts for which there was shown a relationship between interference and the number of assistance cases (03N, 03S, 050, 120) are evenly split between increases and decreases of activity.

When the national picture is considered it can be seen that 1977 was a representative year for assistance case activity:

- Reported Assistance Cases 1975: 16,171
- Reported Assistance Cases 1976: 19,083
- Reported Assistance Cases 1977: 19,137

While the increase in cases in 1977 is not dramatic when compared with 1976, there is no evidence shown to support the hypotheses that 1977 was a slow year nationally. Also, when all of the target Auxiliary districts are considered, there is no reason to believe that 1977 was a below average year. Since the comments received during the interviews were not limited to those Auxiliary districts showing actual decreases in activity, it can be safely assumed that 1977 was a representative year.

Compounding this factor is the reporting rate of Coast Guard Auxiliary activity. The number of assistance cases performed by the 800 Auxiliarists sampled was 9,557. There are 5,137 "active" Auxiliarists in the target districts. An extrapolation of the sample data would indicate that 61,368 assistance cases were performed by "active" Auxiliarists during 1977 in those districts. Extrapolating further results in 123,261 assistance cases performed by "active" Auxiliarists nationwide . Even if those Auxiliarists who performed less than 10 hours of patrol work performed no assistance cases, this data indicates a reporting rate nation wide of only 15.5%. There are factors which probably make that a lower figure than actual. Some of these include:

- o The target districts may have a lower reporting rate than other districts.
- o The data collected may be inflated in that not every Auxiliarist had his copies of reports available during the interview.

It is important to note here that the 1976 Nation Wide Boating Survey reports that the U. S. Coast Guard Auxiliary was the assisting agency in 55,000 situations where boaters required assistance during 1976. The fact that the reporting rates of target verses non-target districts/regions are unknown does throw doubt into this particular extrapolation.

However, the data indicates that there is a serious problem of under reporting of Coast Guard Auxiliary activities. Clearly this factor compounds the difficulty of comparing 1977 data with previous years of data. What can be said is that no significant factor has been uncovered which would support the hypothesis that 1977 was not a representative year for Coast Guard Auxiliary activities.

## 9.0 CONCLUSIONS

It is the conclusion of this study that the Coast Guard Auxiliary SAR/Towing Interference Hazard is an addressable problem. The scope of the problem is worthy of concern in that approximately 10% of "active" Auxiliarists will experience interference. However, it is also the conclusion of this study that those interference cases will not result in significant damage costs on a case by case basis. It is unlikely that any one case of interference will result in more than $50 of damage. In that there were at most 1,653 cases of interference in 1977, any solution which would cost more than $24,342 per year would not be cost beneficial.

The major factor in the nature of this problem is the potential for serious damage and/or injury that could result from interference. The very fact that Auxiliarists have to be aware of interference while performing assistance cases for fellow boater, is in itself annoying. This places an extra burden on the Auxiliarists during sometimes hazardous operations. It is felt that this annoyance at the inconsiderate actions of other boaters has made interference a highly visible problem. This study also leads to the conclusion that interference happens independently of the actions of the Auxiliarists involved. At most, interference acts as a function of the exposure of the Auxiliarists to patrol work and the density of boating activity. Interference will normally happen in the second half of the boating season as the density increases. It may be that the more an Auxiliarist patrols and assists other boaters the more likely he or she is to run across another boater who will cause interference. Most Auxiliarists interviewed felt the interference was unintentional and mainly caused by other ignorance of other boaters. However, since all of the signs and special gear that were studied showed no effect on the rates of interference, it is concluded that the solution to the problem does not lie in this area.

It is the conclusion of this study that the solution of this problem must take the form of an educational solution. It is also concluded that the burden of avoiding damage due to interference must remain with the Auxiliarists performing assistance cases. It is felt the "active" Auxiliarists form the best target for training in recognizing an interference case and performing the necessary maneuvers to avoid damage. The general public represents too large an audience to train in this matter in a cost beneficial manner and they also lack the degree of training in boat maneuvering already possessed by the Auxiliary.

## 10.0 RECOMMENDATIONS

Since testing of distinctive features, type of facility, and special gear carried failed to show any statistically significant relationship to the prevention (or causation) of interference, it is unlikely that any hardware solution would prove effective. Considering the low cost of damage due to interference on a nationwide basis, it is unlikely that any hardware solution would prove cost effective.

While it may be possible that a technical solution coupled with an educational solution could prove effective, it is unlikely that it would be cost effective. The major advantage given for the proposed technical solution (the flashing yellow light) was that it was a device that would be readily recognizable by boaters (i.e. association with tow truck light on the highways). The results of this study show that this is not the case. Therefore, it is concluded that any technical solution, designed to warn boaters would also require an educational program to advise boaters of the meaning of that warning.

The estimated number of boaters who took any action as the result of a boating safety message was only 38.4% of those who observed such a message from a public media source. (Reference the 1976 Nationwide Boating Survey) However, those messages were observed by 91.8% of the boating households in the United States in 1976. While the message content for a solution to interference would not necessarily require any action on the part of the observer other than remembering the message, this data does indicate that complete effectiveness could not be obtained from such an approach. But the over-

riding consideration is cost. Conservative estimates of such a solution would include:

- o $15,000 to produce a TV spot
- o $30 to $4,000 per local station to run a TV spot.
- o Over $100,000 to run a national TV spot.

TV spots were considered for the wide audience they reach (83.2% of those listed in the 1976 Nationwide Boating Survey). Other media would be less costly but also less effective.

When these costs are coupled with the equipment costs of a technical solution distributed to each of the "active" Auxiliarists, the overall costs of this approach are too prohibitive.

In a like manner, since the Auxiliary patrol sign boards were used in almost every case, it is not realistic to think that an enforcement solution would be effective. Most boaters grant Auxiliarists the "power of law enforcement" by heeding speed limit signs they carry during regatta patrols. Since Auxiliary vessels already have this unofficial connotation, it is unlikely that granting them law enforcement authority in cases of interference would change the rate of interference. It is also unlikely that many Auxiliarists would care to be given law enforcement authority in any situation.

Therefore, the one viable form of solution to the interference problem is educational. A public relations approach is eliminated for the cost reasons discussed above. In this light a two pronged solution is recommended. The first area of emphasis is in the area of membership training. All Auxiliarists involved in surface operations should be made aware of the potential problem of interference. They should also be made aware of the probable need for evasive maneuvers to avoid damage should interference develop. It is recommended that the Auxilliary Towing Guide (CG-484) be revised to include mention of towing interfernece and recommended safety

APPENDIX A

SAR/Towing Interference Hazard
Questionnaire

Introduction:

"Hello, I'm calling from J. J. DAVIS ASSOCIATES, INC. and we are preforming work under contract to Coast Guard Headquarters. There should have been a Commandant Notice out explaining the purpose of this contract. We are trying to obtain detailed information about Auxiliary Operations in your area and I was hoping that you might be able to answer some questions for me."

(Verify experience level of Auxiliarist._____
If less than nine hours, end interview.)

Part I

"I would like to ask you some questions concerning your operational experience in the Auxiliary."

"First I need some information about your facility."

1. Manufacturer
2. Length
3. Type
4. Distinguishing features such as:
    1) Flying bridge
    2) Bright color scheme
    3) Unusual markings
    4) Other
    5) None
5. "Is this an Operational Facility?"
6. "Do you carry any additional gear such as:
    1) Bull horn
    2) Spotlights
    3) Signs
    4) Special lights (describe)
    5) Other

7. "Which Rules of the Road are you rigged for?"
   1) International
   2) Great Lakes
   3) Inland
   4) Western Rivers

8. "Do you have towing lights rigged?"
   (If no, skip to #9)

8a. "Are these permanently rigged or portable?"
   (Refer to light table and verify)

9. "How long have you had this boat?"

10. "Have you used it for most of each season each year?"

11. "May I have your age?"
   (If no, do not press for response)

12. "Not counting this year, how many years have you been boating?"

13. "Has that been spent actively boating or 'on and off'?"

14. "How long have you been a member of the Auxiliary?"
   (If less than one year, skip to #16)

15. "What year did you BQ in?"

16. "What is your current Auxiliary Status?"
   (If AUXOP, skip to #18)

17. "Have you passed any of the Specialty Training courses?"

18. "How many assistance cases involving towing have you performed in 1977?"

19. "How many assistance cases not involving towing have you performed in 1977?"
   (If NONE to both 18 and 19, thank Auxiliarist and end interview)

20. "During those assistance cases, have you ever experienced any difficulty with other boats interfering with your work?"
   (If no, continue)
   (If yes, "How many times?"; then skip to Part II)

21. "Was there normally other traffic in the area?"
(If yes, continue.)
(If no, end interview and thank Auxiliarist)

22. "Did you use or do anything to keep other boats clear of your area?"
    1) Signs
    2) Bullhorn
    3) Lights (Describe)
    4) Handwaving
    5) Yelling
    6) Other (Describe)

23. "What were the typical conditions during your assistance cases as far as:
    1) wind
    2) skies
    3) visibility
    4) water conditions
    5) time of day"

Thank Auxiliarist and end interview.

Part II

(Determine how many interference cases can be represented or are typical of the Part II data.)

(Complete at least one Part II section for each Auxiliarist reporting interference.)

1. "Where did the interference occur?"
2. "What was the traffic situation like?"
3. "What month of the year did this happen?"
4. "What were the weather conditions:
    1) wind
    2) skies
    3) visibility
    4) water conditions"

5. "What time of day was it?"
   (If daylight hours, skip #7)
   (If dark or if visibility was a factor, continue)
6. "What day of the week did the interference happen on?"
7. "Did you have your navigation lights on?"
8. "Were there many other lights in the area?"
9. "What type of assistance case were you performing?"
   (If other than towing, skip to #12)
10. "Was the tow lighted?"
11. "Were you burning towing lights?"
12. "What type of vessel were you assisting?"
    1) Manufacturer
    2) Length
    3) Type
13. "What type of boat caused the interference?"
    1) Manufacturer
    2) Length
    3) Type
14. "What was the interfering boat doing at the time of the interference?"
15. "Would you say that the interference was intentional?"
    (If yes, skip to #17)
16. "Did they have control of the interfering boat?"
17. "Were you using anything to warn the other boat about what you were doing?"
    1) Bullhorn
    2) Patrol signboard
    3) Use of lights (flashing them, etc.)
    4) Rotating light
    5) Change of course
    6) Handwaving
    7) Yelling
    8) Other
18. "What type of approach did the interfering boat have?"

20. "Did the interference cause any damage?"
    (If yes, go to #21)
    (If no or near miss, skip to #23)
21. "What was damaged?"
22. "How much did it cost or how much do you think it would cost to repair the damage?"

(Ask the following questions only for cases involving towing.)

23. "How were you towing the vessel you were assisting?"
    (If astern, continue)
    (If not astern, end interview and thank Auxiliarist)
24. "What was the length of the tow?"

Thank Auxiliarist for the cooperation and end interview.

APPENDIX B

CODING INSTRUCTIONS

PART I

Member Number ___/___/___/___ (3) (2) (2) (3)

Experience Level (Patrol hours) ___ (3)

Facility Data

1. Manufacturer (List 1: Manf. codes) ___ (3)

2. Length (In feet) ___ (3)

3. Type (See list 2) ___ (2)

4. Features (code 1=Yes, 0=No, 9=N/A for each)

1) Flying bridge ___ (1)

2) Color scheme ___ (1)

3) Markings ___ (1)

4) Other ___ (1)

5) None ___ (1)

5. Operational facility (code 1=Yes, 0=No) ___ (1)

6. Additional Gear (code 1=Yes, 0=No, 9-N/A for each)

1) Bull Horn ___ (1)

2) Spot Lights ___ (1)

3) Signs ___ (1)

4) Special Lights (describe_____) ___ (1)

5) Other (describe_____) ___ (1)

7. Rules of the Road (code only one) _____ (1)
   1 = International
   2 = Great Lakes
   3 = Inland
   4 = Western Rivers

8. Towing Lights (code 1=Yes, 0=No, 9=N/A) _____ (1)

8a. Lights Rigged (code only one) _____ (1)
   1 = Permanently
   2 = Portable
   3 = N/A

9. Length of Ownership (in years) _____ (2)

10. Use Most of each Season (code 1=Yes, 0=No, 9-N/A) _____ (1)

11. Age (in years) (99=not given) _____ (2)

12. Boating Years (in years) _____ (2)

13. Activity (code 1=Active, 5=Off and On) _____ (1)

14. Years Service (in years) _____ (2)

15. BQ Year (99=N/A) _____ (2)

16. Status (code only one) _____ (1)

17. Specialty Training (code 1-Yes, 0=No, 9=N/A for each)
   1) SAR _____ (1)
   2) COMM _____ (1)
   3) PAT _____ (1)
   4) WX _____ (1)
   5) SEA _____ (1)
   6) PIL _____ (1)
   7) ADM _____ (1)

18. # Towing Assists _____ (3)

19. # Non-Towing Assists _____ (3)

20. # Interference Cases _____ (3)

21. Traffic (code only one) _____ (1)
    2 = Clear
    0 = Congested
    1 = Some traffic

22. Actions to Avoid (code 1=Yes, 0=No, 9=N/A for each)
    1) Signs _____ (1)
    2) Bull Horn _____ (1)
    3) Lights (describe_____) _____ (1)
    4) Hand Waving _____ (1)
    5) Yelling _____ (1)
    6) Other (describe_____) _____ (1)

23. Typical Conditions
    Wind (See List 3) _____ (1)
    Skies (See List 4) _____ (1)
    Visibility (See List 6) _____ (1)
    Water Conditions (See List 6) _____ (1)
    Time of Day (See List 7) _____ (1)

PART II

Member Number _____ (3) (2) (2) (2)

Representative of # Cases _____ (2)

1. Body of Water (code only one) _____ (1)
   1 = Ocean/Gulf
   2 = Great Lakes (not tributaries)
   3 = Bays, inlets, sounds, harbors, ICW
   4 = Rivers, streams, creeks
   5 = Lakes, ponds, reservoirs, dams, gravel pit
   6 = Other
2. Traffic (code only one) _____ (1)
   0 = Clear
   1 = Some
   2 = Congested
3. Month of Year (two digit code) _____ (2)
4. Conditions (code for each)
   1) Wind (See List 3) _____ (1)
   2) Skies (See List 4) _____ (1)
   3) Visibility (See List 5) _____ (1)
   4) Water Conditions (See List 6) _____ (1)
5. Time of Day (See List 7) _____ (1)
6. Day of Week (code 1=Sunday, 2=Monday, etc.) _____ (1)
7. Navigation Lights (code 1=Yes, 0=No, 9=N/A) _____ (1)
8. Other Lights (code only one) _____ (1)
   1 = Lights on Shore
   2 = Other Traffic
   3 = A to N Lights
   4 = Other (describe_____)
   5 = N/A

9. Type of Assistance (code only one) _____ (1)
   1 = Towing
   2 = Dewatering
   3 = Boater Lost
   4 = Boater out of Fuel
   5 = Other

10. Tow Lighted (code 1=Yes, 0=No, 9=N/A) _____ (1)

11. Towing Lights (code 1-Yes, 0=No, 9=N/A) _____ (1)

12. Assisted Vessel:
   1) Manufacturer (See List 1: Manf. codes) _____ (3)
   2) Length (in feet) _____ (3)
   3) Type (See List 2) _____ (2)

13. Interfering Vessel:
   1) Manufacturer (See List 1: Manf. codes) _____ (3)
   2) Length (in feet) _____ (3)
   3) Type (See List 2) _____ (2)

14. Interfering Boat Activity (Code only one) _____ (1)
   1 = Cruising at high speed
   2 = Cruising at normal or slow speed
   3 = Maneuvering
   4 = Water skiing
   5 = Water skiing with skier down
   6 = Racing
   7 = Other

15. Intentional (Code 1=Yes, 0=No, 9=N/A) _____ (1)

16. Control of Boat (code 1-Yes, 0=No, 9=N/A) _____ (1)

17. Warning Attempted (code 1=Yes, 0=No, 9=N/A for each)

1) Bull Horn _____ (1)

2) Patrol Sign Board _____ (1)

3) Use of lights (Flashing them, etc.) _____ (1)

4) Rotating Light _____ (1)

5) Change of Course _____ (1)

6) Handwaving _____ (1)

7) Yelling _____ (1)

8) Other _____ (1)

18. Approach (code only one) _____ (1)

1 = Head On
2 = Overtaking
3 = Crossing
4 = Other

19. Auxiliary Markings (code 1 = Yes, 0 = No, 9 = N/A for each)

1) Auxiliary Ensign (1)

2) Patrol Signboards (1)

3) Auxiliary Decals (1)

4) Other (Describe_____) (1)

20. Damage (code 1 = Yes, 0 = No, 3 = Near Miss) (1)

21. Vessel damaged (code only one) (1)

1 = Your Facility
2 = The Vessel Being Assisted
3 = Your Gear (such as the towing rig)

22. Damage Estimate (code only one) _____ (1)

1 = Less Than $50
2 = $50 to 99
3 = $100 to 199
4 = $200 to 299
5 = $300 to 999
6 = $1,000 to $2,000
7 = More Than $2,000
8 = Didn't Pay for Repairs

23. Method of Tow (code only one) _____ (1)

1 = Astern
2 = Along Side
3 = Other (describe _____)

24. Length of Tow (In feet) _____ (3)

AD-A062 579 DAVIS (J J) ASSOCIATES INC MCLEAN VA F/G 15/3
A CAUSE IDENTIFICATION REPORT OF COAST GUARD AUXILIARY SAR/TOWI--ETC(U)
SEP 78 J CLARKE, D THURSTON, J ELDREDGE DOT-CG-73369-A
UNCLASSIFIED USCG-D-67-78 NL

2 OF 2
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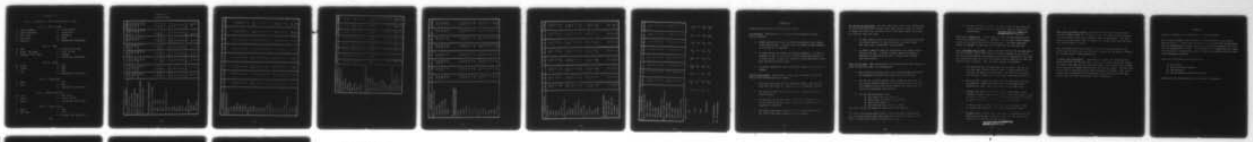

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CODING LISTS

LIST 1: LISTING OF 3 DIGIT MANUFACTURER"S CODES

LIST 2: TYPE OF BOAT

1. Open Motorboat
2. Cabin Motorboat
3. Aux. Sail
4. Sail Only
5. Row Boat
6. Canoes/Kayaks
7. Inflatables
8. Houseboat
Ø. Other
9. Unknown/Not Applicable

LIST 3: WIND

Ø. None
1. Light (0-6 mph)
2. Moderate (7-14 mph)
3. Strong (15-25 mph)
4. (over 25 mph)
5. Unknown
9. Unknown/Not Applicable

LIST 4: SKIES

Ø. Clear
1. Cloudy
2. Fog
3. Rain
4. Snow
5. Hazy
9. Unknown/Not Applicable

LIST 5: VISIBILITY

1. Good
2. Fair
3. Poor
4. Dark
9. Unknown/Not Applicable

LIST 6: WATER CONDITIONS

Ø. Calm
1. Choppy
2. Rough
3. Very Rough
4. Strong Current
9. Unknown/Not Applicable

LIST 7: TIME OF DAY

1. Dawn
2. Day Time
3. Dusk
4. Night
9. Unknown/ Not Applicable

| DISTRICT/REGION | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Hours on Patrol | 11,376 | 3,284 | 13,746 | 4,636 | 10,431 | 3,450 | 8,795 | 55,851 |
| # of Towing Assists | 1,520 | 608 | 1,117 | 394 | 788 | 380 | 1,139 | 5,909 |
| # of Non-Towing Assists | 580 | 1,100 | 500 | 214 | 546 | 225 | 481 | 3,648 |
| Total Assist Cases | 2,100 | 1,708 | 1,617 | 608 | 1,334 | 533 | 1,620 | 9,557 |
| Aux. Experiencing Interference | 16 | 4 | 12 | 10 | 8 | 9 | 19 | 78 |
| # of Interference Cases | 39 | 5 | 19 | 18 | 8 | 11 | 46 | 146 |
| Interference Characteristics | | | | | | | | |
| % Distribution by Season: | | | | | | | | |
| Jan. - Mar. | 0 | 0 | 0 | 0 | 0 | 0 | 2.2 | 0.7 |
| Apr. - Jun. | 13.2 | 40.0 | 0 | 5.6 | 25.0 | 36.4 | 46.7 | 24.3 |
| Jul. - Sep. | 86.8 | 60.0 | 94.7 | 94.4 | 75.0 | 54.5 | 48.9 | 72.9 |
| Oct. - Dec. | 0 | 0 | 5.3 | 0 | 0 | 9.1 | 2.2 | 2.1 |
| % Distribution by Day: | | | | | | | | |
| Sun. | 31.4 | 66.6 | 7.7 | 53.3 | 62.5 | 44.4 | 8.9 | 27.3 |
| Mon. | 37.2 | 0 | 7.7 | 0 | 0 | 11.1 | 0 | 11.7 |
| Tues. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wed. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Thurs. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fri. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sat. | 31.4 | 33.3 | 84.6 | 46.7 | 37.5 | 44.4 | 91.1 | 60.9 |
| Type of Case: | | | | | | | | |
| Towing | 34 | 3 | 17 | 17 | 7 | 8 | 43 | 129 |
| Other | 3 | 1 | 0 | 0 | 1 | 1 | 2 | 9 |
| Not Given | 2 | 1 | 2 | 1 | 0 | 2 | 1 | 8 |

| DISTRICT/REGION | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Weather Conditions | | | | | | | | |
| Winds: | | | | | | | | |
| None | 3 | 0 | 2 | 1 | 0 | 0 | 1 | 7 |
| Light | 22 | 4 | 6 | 6 | 5 | 8 | 15 | 66 |
| Moderate | 1 | 1 | 10 | 8 | 1 | 1 | 6 | 28 |
| Strong | 1 | 0 | 1 | 3 | 2 | 2 | 20 | 29 |
| Storm | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Unknown | 11 | 0 | 0 | 0 | 0 | 0 | 4 | 15 |
| Skies: | | | | | | | | |
| Clear | 26 | 4 | 16 | 17 | 6 | 9 | 40 | 118 |
| Cloudy | 0 | 1 | 2 | 1 | 1 | 0 | 2 | 7 |
| Fog | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Rain | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 4 |
| Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hazy | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Unknown | 11 | 0 | 1 | 0 | 0 | 0 | 3 | 15 |
| Visibility: | | | | | | | | |
| Good | 26 | 4 | 17 | 16 | 7 | 6 | 40 | 116 |
| Fair | 2 | 1 | 2 | 0 | 0 | 3 | 2 | 10 |
| Poor | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 4 |
| Dark | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Unknown | 11 | 0 | 0 | 1 | 0 | 0 | 3 | 15 |
| Water Conditions: | | | | | | | | |
| Calm | 15 | 0 | 7 | 2 | 3 | 4 | 14 | 46 |
| Choppy | 9 | 4 | 10 | 13 | 4 | 6 | 10 | 56 |
| Rough | 4 | 0 | 0 | 2 | 0 | 0 | 18 | 24 |

| DISTRICT/REGION | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Interference Characteristics | | | | | | | | |
| Water Conditions (Cont.): | | | | | | | | |
| Very Rough | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 3 |
| Strong Current | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| Unknown | 11 | 0 | 1 | 0 | 0 | 0 | 3 | 15 |
| Time of Day: | | | | | | | | |
| Dawn | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Day Time | 26 | 5 | 14 | 17 | 6 | 8 | 42 | 118 |
| Dusk | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 7 |
| Night | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 7 |
| Unknown | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Data For All Assistance Cases | | | | | | | | |
| Type of Facility: | | | | | | | | |
| Open Motorboat | 32 | 22 | 63 | 16 | 26 | 36 | 25 | 221 |
| Cabin Motorboat | 147 | 19 | 118 | 47 | 82 | 31 | 56 | 500 |
| Aux. Sail | 1 | 2 | 7 | 1 | 1 | 2 | 3 | 17 |
| Sail Only | | 1 | 1 | | | | | 2 |
| Row Boat | | | | | | | | 0 |
| Canoes/Kayaks | | | | | | | | 0 |
| Inflatables | | | | | | | | 0 |
| Houseboat | 3 | | 3 | 1 | 4 | 8 | | 14 |
| Other | 3 | | 1 | 3 | 0 | 0 | 1 | 8 |
| Unknown | 8 | 4 | 5 | 2 | 11 | 3 | 5 | 38 |
| Type of Distinctive Features: | | | | | | | | |
| Flying Bridge | 66 | 12 | 53 | 20 | 22 | 10 | 15 | 198 |
| Bright Color Scheme | 38 | 8 | 20 | 5 | 20 | 10 | 15 | 116 |
| Unusual Marking | 7 | 1 | 4 | 0 | 2 | 1 | 1 | 16 |
| Other | 15 | 2 | 5 | 6 | 9 | 8 | 11 | 56 |

| DISTRICT/REGION | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Additional Gear Carried: | | | | | | | | |
| Bullhorn | 151 | 31 | 131 | 55 | 98 | 59 | 83 | 610 |
| Spotlights | 182 | 43 | 190 | 62 | 110 | 67 | 85 | 741 |
| Patrol Signs | 182 | 43 | 177 | 69 | 113 | 73 | 81 | 740 |
| Special Lights | 40 | 3 | 18 | 5 | 10 | 1 | 11 | 88 |
| Other | 28 | 4 | 10 | 9 | 10 | 17 | 22 | 100 |
| Typical Weather Conditions (Non-Interference Only) | | | | | | | | |
| Wind: | | | | | | | | |
| None | 53 | 10 | 83 | 24 | 53 | 36 | 40 | 224 |
| Light | 49 | 11 | 47 | 13 | 26 | 12 | 17 | 175 |
| Moderate | 54 | 14 | 43 | 19 | 20 | 15 | 19 | 182 |
| Strong | 15 | 3 | 8 | 5 | 7 | 6 | 8 | 52 |
| Storm | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Unknown | 22 | 10 | 17 | 9 | 18 | 4 | 6 | 86 |
| Skies: | | | | | | | | |
| Clear | 135 | 23 | 141 | 46 | 90 | 62 | 77 | 498 |
| Cloudy | 15 | 8 | 26 | 14 | 12 | 4 | 2 | 81 |
| Fog | 2 | 1 | 2 | 0 | 0 | 2 | 4 | 11 |
| Rain | 3 | 0 | 1 | 2 | 0 | 1 | 0 | 7 |
| Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hazy | 9 | 1 | 3 | 1 | 1 | 1 | 0 | 16 |
| Unknown | 30 | 15 | 25 | 7 | 21 | 4 | 7 | 108 |

| DISTRICT/REGION | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Visibility: | | | | | | | | |
| Good | 106 | 28 | 87 | 33 | 49 | 32 | 38 | 373 |
| Fair | 14 | 7 | 14 | 8 | 7 | 5 | 3 | 58 |
| Poor | 3 | 1 | 1 | 0 | 0 | 0 | 2 | 6 |
| Dark | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 4 |
| Unknown | 70 | 2 | 11 | 29 | 67 | 37 | 47 | 279 |
| Water Conditions: | | | | | | | | |
| Calm | 86 | 15 | 106 | 33 | 67 | 45 | 51 | 327 |
| Choppy | 70 | 14 | 61 | 19 | 28 | 21 | 27 | 240 |
| Rough | 12 | 8 | 7 | 10 | 6 | 3 | 4 | 49 |
| Very Rough | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| Strong Current | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| Unknown | 23 | 11 | 24 | 7 | 22 | 5 | 8 | 100 |
| Time of Day: | | | | | | | | |
| Dawn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Daytime | 119 | 29 | 101 | 40 | 57 | 37 | 45 | 428 |
| Dusk | 14 | 4 | 9 | 1 | 10 | 3 | 2 | 41 |
| Night | 3 | 0 | 3 | 0 | 0 | 1 | 2 | 9 |
| Unknown | 58 | 5 | 85 | 29 | 57 | 33 | 1 | 243 |
| | | | | | | | | |
| Interference Results | | | | | | | | |
| Damage Estimate: | | | | | | | | |
| Less than $50 | 1 | 0 | 0 | 4 | 0 | 5 | 33 | 43 |
| Greater than $50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No Damage | 38 | 5 | 19 | 14 | 7 | 6 | 13 | 102 |
| Unknown | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |

| DISTRICT/REGION | | 3N | 3S | 5 | 9C | 9E | 9W | 12 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Type of Vessel Assisted: | | | | | | | | | |
| Open Motorboat | | 12 | 4 | 12 | 10 | 5 | 7 | 10 | 60 |
| Cabin Motorboat | | 23 | 1 | 5 | 1 | 2 | 3 | 28 | 63 |
| Aux. Sail | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Sail Only | | 2 | 0 | 2 | 1 | 0 | 0 | 1 | 6 |
| Houseboat | | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 5 |
| Unknown/Not Given | | 0 | 0 | 0 | 6 | 0 | 1 | 4 | 11 |
| Type of Vessel Interfering: | | | | | | | | | |
| Open Motorboat | | 18 | 4 | 3 | 10 | 3 | 8 | 3 | 49 |
| Cabin Motorboat | | 13 | 1 | 8 | 3 | 3 | 1 | 10 | 39 |
| Aux. Sail | | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 6 |
| Sail Only | | 4 | 0 | 5 | 0 | 1 | 1 | 21 | 32 |
| Houseboat | | 2 | 0 | 0 | 0 | 0 | 1 | 4 | 7 |
| Unknown/Not Given | | 0 | 0 | 3 | 5 | 1 | 0 | 4 | 13 |
| Membership Training* | | | | | | | | | |
| BQ | I | 15 | 3 | 10 | 10 | 8 | 9 | 14 | 69 |
| | N | 163 | 38 | 158 | 60 | 113 | 57 | 63 | 652 |
| AUXOP | I | 1 | 1 | 2 | 0 | 0 | 0 | 5 | 9 |
| | N | 17 | 6 | 28 | 0 | 3 | 8 | 8 | 70 |
| SAR | I | 3 | 1 | 7 | 1 | 2 | 1 | 8 | 23 |
| | N | 54 | 16 | 83 | 12 | 27 | 19 | 18 | 229 |
| Seamanship | I | 9 | 1 | 6 | 0 | 3 | 2 | 11 | 32 |
| | N | 66 | 16 | 77 | 9 | 21 | 15 | 19 | 223 |

*I = Interference

*N = No Interference

## APPENDIX D

Suggested Outline for Flotilla Training Topic

Introduction: Presentation of statistical background of interference problem.

1. Almost one out of every ten active Auxiliarist will experience interference. (Relate this to number of Auxiliarists in flotilla or at meeting).

2. It could happen on almost any towing operation. In fact it happened in one out of every 40 towing assistance cases in a recent study. (Interject how many towing assistance cases your flotilla did last year).

3. It may be costing as much as $24,000 a year as a result of damage.

Typical Conditions: Description of the type of weather conditions during which interference may happen.

1. Generally the winds will be slightly higher. But for the most part wind does not appear to be an important factor.

2. The sky will most likely be clear as it was in 81% of the cases studied.

3. Visibility will be good most of the time. Less than 4% of the cases occurred in poor visibility and less than 1% happened in the dark.

4. The water conditions may be a little rougher than normal but 32% of the cases happened in calm waters.

Who Should be Concerned: You may think that you're very experienced or you've patrolled for so many hours that you don't have to worry. Or maybe you think your facility is so large that people can't miss you and will give you room.

1. In some cases the more an Auxiliarist patrolled or the more assistance cases he or she performed, the more likely they were that interference would happen.

2. It doesn't seem to make any difference as to what type of facility you use. A small runabout seems as likely to experience interference as does a large cabin cruiser (and vice versa).

What Can be Done: Many things have already been tried and they don't seem to have any effect on interference.

1. Even if you're sitting up on your flying bridge surrounded by runabouts, you still may experience interference.

2. You can use a really bright color scheme on your hull or put really unusual markings on your bow (such as your flotilla number in four foot bold numbers) but your still as likely to experience interference.

3. You can equip yourself with:
   - bull horns and loud hailers,
   - spotlights, portable and permanent,
   - patrol sign boards,
   - and even special flare up lights,

but you're still as likely to experience interference.

All these things have been tried in districts where interference was a problem people have been complaining about for years. They haven't shown any evidence of doing any good!

4. You can even put a special flashing light on your boat and it still wouldn't make you any less likely to experience interference.



Whom Can it Happen to: It can happen to each and any Auxiliarists performing towing operations. Remember, it will most likely happen to one out of every ten active Auxiliarists! The most important thing to remember is that you can be that one out of every ten.

O.K., Now What Can be Done: About the best thing to do is keep aware of the problem. Be on the lookout for other boaters in your area. You all know we should have someone watching the towline at all times. The reason for that is to let the skipper keep a good eye on what the other traffic is doing. Here are some things to consider:

1. The other guy may not know what you're doing. He may not even see that 16 foot outboard you're towing behind you. Give him the benefit of the doubt. Be ready to slow down for his wake. Warn your crew so they know what's going on.

2. Even if you're sure the others can see what you're doing, be prepared. Assume everyone else on the water will be ignorant and rude. Be ready to get out of their way.

3. Remember the Rules of the Road. The restrictions on the "stand-on vessel" against maneuvering apply only after a risk of collision exists. If possible maneuver out of people's way before you get to the risk of collision phase.

4. If worse comes to worse, sound your danger signal. Make the other boat know that you think something's wrong.

5. Remember that in over 70% of the cases of interference the Auxiliarist was able to maneuver the facility and the tow safely out of the way and avoid damage.

What About the Other Fellow: The boater causing the interference probably doesn't mean it. In most of the 146 cases studied recently, the other boater just didn't realize what was happening. As Auxiliarists you are better able to handle your vessel (and your tow) and you now know what to expect.

The only thing that can be done is to try to reach as many of the other boaters as you can and let them be aware of the type of trouble they might cause a towing operation.

Is There Any "Good News": Yes there is. Even if everything goes wrong and yours is the one case in every 137 towing cases that result in damage, the odds are still on your side. In all the cases studied, none resulted in damage costing more than $50 to repair. So more than likely you'll only end up with some scratches or knicks. But, by at least being forewarned of the possibilities, you may beat the odds and be able to avoid interference cases completely.

## APPENDIX E

Suggested Pamphlet for Distribution to General Public

The attached pamphlet was designed for distribution to the general boating public. It portrays the message of unintentional interference and the consequences of such actions. It has been designed with economical reproduction in mind. Its purpose is to communicate the important aspects of interference cases as simply as possible with no other safety messages intended.

Suggested distribution points would be:

- Boat Shows
- Marina and Boat Dealers
- CME Stations
- Public Education Boating Classes.

Quantities for distribution are discussed in Appendix F.

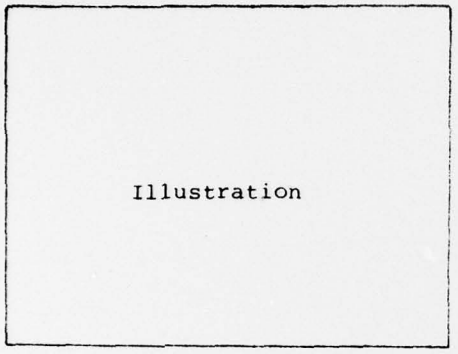
FOR FURTHER
INFORMATION CONTACT
YOUR LOCAL

U.S. COAST GUARD AUXILIARY

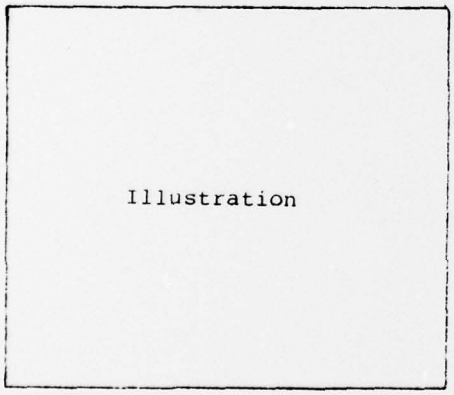
# IN BOATING . . .

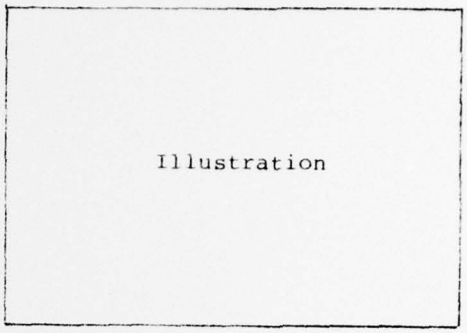
# CLOSE ENCOUNTERS OF ANY KIND ARE OF THE WRONG KIND

As most boaters know coming close to another boat can sometimes cause serious problems. If that other boat is towing another boat, those problems can become even more serious.

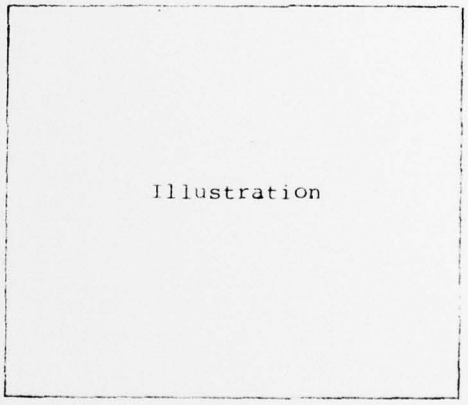



It can't avoid you as it normally would - it's got a few thousand pounds of boat acting like an anchor on its stern. But that anchor will crash into it if it stops suddenly.




So if you see a **Coast Guard Auxiliary** boat, give him some room. He may just be towing one of your friends into port. And your friend won't appreciate your interference.




In fact the chances are you'll cause damage to his boat and the Auxiliary boat. So don't be a **U.F.O.** *

*UNINTENTIONALLY FRUSTRATING OBJECT

## APPENDIX F

Cost Estimates for Distribution of Suggested Solution

The cost estimates for the distributions of the suggested solution rely in part on the effectiveness of the solution once employed. Since it is unrealistic to expect either form of the recommended action to be 100% effective some measures must be estimated. The highest probability of successful corrective action lies in the area of Auxiliary Membership Training. Some of the reasons for this are:

- The active Auxiliarists represent a smaller audience and therefore can be reached more efficiently.

- The Auxiliarists are actively concerned with the problem and therefore should be the most receptive of suggested solutions.

- There is no accurate method of directing this message to a target segment of the boating public. The profile information is not available for the segment of the public causing interference. In fact, the data tends to indicate that it may not be just one segment of the boating public causing interference. It may be a characteristic of the generally uneducated (in boating) boating public.

- Unless the intended audience is interested in the subject matter, an educational message will not be retained.

Therefore, a realistic estimate of the extent of the problem which can be solved can be made at 75%. This estimate assumes that a high percentage of the "active" Auxiliarists receive the training message and are at least made aware of the need for possible emergency maneuvers. It also assumes that this training will allow the Auxiliarists to recover from 93% of the interference cases without damage. That represents the 70.5% of the cases they have already

avoided damage on plus 75% of the cases during which damage resulted in 1977. The 75% estimate also assumes that at least some of the boating public is made aware of the problem of interference. But the majority of the burden of avoidance is placed on the Auxiliarist involved in the cases.

If the established goal of effectiveness is reached, it would represent a maximum savings of $18,256.50 to the Coast Guard per year. This is a maximum savings in that it assumes that:

1. the target districts and the non-target districts will experience the same levels of interference,
2. that each of the cases that result in damage will cost $50 to repair and,
3. that all the Auxiliarists experiencing interference damage will submit claims for reimbursement.

Therefore, it should be stated that a 75% effective educational solution could save the Coast Guard $18,256.50 per year. Added to that cost figure would be such factors as Auxiliarists satisfaction with patrol work, Auxiliarists' morale, and the Auxiliary's opinion of the Coast Guards responsiveness to this problem. Those factors could increase the amount of potential "savings" to the Coast Guard but they would require cost estimations which are beyond the scope of this project.

For the purpose of this analysis it will be assumed that the suggested solution has a cost ceiling of $18,256.50.

The reproduction costs of the Flotilla Training Topic Outline should prove less than 10¢ a copy if 5,000 or more copies are made. Distribution of these copies could be made through the normal Auxiliary supply channels at little or no cost. Allowing for more copies or higher reproduction costs, the Flotilla Training Topic should not cost more than $1,000. The use of Auxiliary Instructors at regular meetings would not add to the cost of this solution.

The inclusion of the pamphlet material in the next revision of the BS&S course and the revision of the Auxiliary Towing Guide (CG-484) would be basically cost free items for the Coast Guard.

It is estimated that in quantities of greater than 100,000 copies the pamphlet would cost less than 3¢ per copy. Therefore, the Coast Guard could print and distribute 570,000 copies of such a pamphlet. Distribution would be to Coast Guard Auxiliary Flotillas and Marine Dealers. Any larger distribution would exceed the maximum cost/benefit constrictions unless the other factors mentioned above are taken into consideration.

Obviously, these figures would have to be modified in future years if the annual occurrence of interference increases or decreases if the cost/benefit ratio is to be maintained.